LUND UNIVERSITY
School of Economics and Management

*Department of Informatics*

# Business Intelligence for Environmental Sustainability

## A Qualitative Study on Swedish Municipalities' Technology Adoption

Master thesis 15 HEC, course INFM10 in Information Systems

Authors: Eleonora Lyvall
Linnea Persson

Supervisor: Betty Saenyi

Grading Teachers: Osama Mansour
Avijit Chowdhury

# Business Intelligence for Environmental Sustainability: a Qualitative Study on Swedish Municipalities' Technology Adoption

AUTHORS: Eleonora Lyvall and Linnea Persson

PUBLISHER: Department of Informatics, Lund School of Economics and Management, Lund University

PRESENTED: May, 2024

DOCUMENT TYPE: Master Thesis

FORMAL EXAMINER: Osama Mansour, Associate professor

NUMBER OF PAGES: 80

KEY WORDS: Business Intelligence, Environmental Sustainability, Municipality, Critical Success Factors, Integrated T-O-E Framework

ABSTRACT:
This master's thesis explores the importance of CSFs for business intelligence implementation for environmental sustainability initiatives from municipal employees' perspectives, aiming to increase the understanding of the selected field. The qualitative study is based on semi-structured interviews with six employees. The collected data was analysed and discussed with a template analysis based on the theoretical framework. The findings of the study confirm some of the results of previous studies, indicating numerous CSFs perceived as important. The study also identified three additional CSFs tailored to the municipal context: available technology, available time, and governmental support. In addition, the findings also highlight discrepancies with existing literature where the unique municipal context influences how different CSFs are perceived and prioritised. Thus, this master's thesis contributes with knowledge to the field of information systems by improving the understanding of the current discourse for business intelligence and environmental sustainability in a municipal context. As well as provides an extension of the Integrated T-O-E framework. Finally, the thesis offers valuable insights which are of interest to Swedish municipalities and other governmental institutions working with the intersection of BI and environmental sustainability.

# Acknowledgements

We would like to express our gratitude to the six respondents who took the time to participate in an interview and share their thoughts and experiences. Furthermore, we would like to extend a special thank you to our supervisor, Betty Saeny, whose support and guidance have meant a great deal to us throughout the entire process.

May, 2024

Eleonora and Linnea

# Content

# Figures

# Tables

# 1 Introduction

Worldwide, climate change is affecting various aspects of our societies when it comes to water, ecosystems, food security, infrastructure, health, and economies (IPCC, 2022). Simultaneously, there is an expected move of European residents to both large cities and coastal areas, leading to an increase in urban population which will expose more people to the climate impacts that are disrupting the infrastructure of the cities (IPCC, 2022). As the infrastructure is key to providing services to residents within the cities, climate change presents a significant challenge to be handled in urban areas for its local government.

Consequently, an increasing number of local governments are now engaging in sustainable development (SKR, 2023c), and the role of municipalities in sustainability work is varied. Firstly, they act as authorities through inspections to ensure that companies are complying to environmental rules and regulations (RUS, 2020). Secondly, they serve as enablers by facilitating a physical sustainable environment, promoting sustainable consumption, and fostering a sustainable business sector (RUS, 2020). Thirdly, as operators, managing local facilities and conducting public procurement, which accounts for a significant portion of the Swedish GDP (RUS, 2020). Finally, they act as exemplars, spreading knowledge and serving as role models in shifting towards a more sustainable society (RUS, 2020).

Today, municipalities adhere to the Local Government Act (SFS 2017:725) and particularly the Municipal Accounting Act (SFS 2018:597). This particular act does not contain any incentives regarding their responsibilities for sustainability reporting, meaning that municipalities by themselves decide to report on sustainability or not (SFS 2018:597; SKR, 2023c). However, according to the Instrument of Government (SFS 1974:152), the public sector shall promote sustainable development that leads to a good environment for current and future generations. In 2023 two-thirds of Swedish municipalities had a political overarching goal to reduce their climate impact (SKR, 2023c). However, only 60 percent of the municipalities had a de facto action plan for the governance and implementation of these climate goals (SKR, 2023c).

At the same time, according to SKR (2023d) municipalities play a crucial role in translating sustainability commitments into tangible action. Therefore, even though municipalities are not required to report the sustainability work, various authorities inquire for a follow-up on the work being done (SKR, 2023d). The increased incentives for sustainability work and sustainability reporting, entails heightened requirements for following key performance indicators (KPIs), which imposes new demands on data management in order to gather all data necessary (PWC, 2023). For this purpose, technologies and particularly those for modelling and monitoring can be utilised to address and prepare for climate risks and achieve sustainability goals (Ziemba, 2021; IPCC, 2022). Big data technologies, advanced analytics, and business intelligence (BI) are essential for cities in order to monitor, understand, analyse, and plan cities (Bibri & Krogstie, 2020; Visvizi et al. 2018; Petrini & Pozzebon, 2009), as well as for improving sustainability indicators and routines (Bengtsson & Ågerfalk, 2011). Business intelligence systems and tools enhance decision-making in organisations (Sharda et al. 2018) and can be specifically used regarding sustainability aspects (Petrini & Pozzebon, 2009).

Still, the public sector faces specific challenges related to digital innovation for sustainability, including inconsistent digital maturity, non-digital mindset, slow mobilisation, service-based silos, premature solutioning, and alignment issues (Joukhadar et al. 2023). Addressing these challenges requires a comprehensive approach to bridge the digital capability gap and overcome core rigidities, ultimately ensuring the delivery of public value to citizens and the environment for a sustainable future in cities (Joukhadar et al. 2023). As cities confront the challenges of climate change, the importance of sustainable development becomes increasingly clear, and technologies such as business intelligence can offer practical solutions to address these challenges. Exploring how municipalities actually are addressing these challenges with these tools is therefore imperative for future work with building resilient and environmentally sustainable cities.

## 1.1 Problem Identification

As emphasised by Kirst and Lang (2019) municipalities play a critical role in the local development of sustainable solutions. However, they face several challenges such as integrating sustainability into the organisation and developing a successful sustainability strategy (Kirst & Lang, 2019). The public sector must be innovative and facilitate technology in their work with sustainable development (Joukhadar et al. 2023). Yet, digital innovation in the public sector is receiving less attention from research and is lagging behind compared to the private sector (Joukhadar et al. 2023). Hence, Joukhadar et al. (2023) emphasise that digital innovation requires further research to achieve sustainable development in the public sector. Additionally, Gholami et al. (2016) stress that the information systems (IS) discipline must address the sustainability challenge as there is a need for practical solutions regarding how IS can be utilised to reduce negative environmental impacts.

Today, some municipalities are using business intelligence in their operations (Ripgården, 2021). However, 61 percent of 50 Swedish municipalities lacked a long-term plan regarding their analytics work and most municipalities were only in the start of their data-driven journey, as a central coordination for the work with analytics was missing (Ripgården, 2021). Carlsson et al. (2023) assert that while the public sector has experience in implementing digital solutions, municipalities are often criticised for adopting available technology later than other sectors. Investigating the adoption and implementation of business intelligence within municipalities is therefore vital and timely for the purpose of uncovering factors that contribute to a successful implementation. Especially, as these systems can provide specific benefits that support sustainability efforts when considering how people, management, and technology work together to make these benefits happen (Seidel et al. 2013).

Cheng et al. (2023) argue that an organisation's sustainability performance can be improved through an efficient analysis of big data. When an organisation properly facilitates BI&A (business intelligence and analytics) capabilities it can enhance and improve the organisation's sustainability capabilities (Zhang et al. 2022; Zaamer et al. 2022). As stated by Shi et al. (2023) BI&A enhance employees' and managers' ability to efficiently identify environmental issues to enhance sustainability performance. Moreover, BI&A technologies, such as visualisation of data, facilitate members in the organisation to reflect on sustainability performance because it increases the visibility of different outcomes (Shi et al. 2023). Without BI&A, organisations might struggle to collect relevant information about sustainability performance and therefore affect their ability to gain insights and make better decisions (Shi et al. 2023). According to Zhang et al. (2022) decisions regarding sustainability cannot be

based on instincts, instead it must be based on adequate information. Furthermore, without BI&A, organisations have limited information and understanding of sustainability issues, and they risk failing to convert BI&A capabilities into sustainability capabilities (Zhang et al. 2022). Moreover, when implementing sustainability into BI it is important to not overlook the organisational context, as the organisation must adapt an innovative culture and build knowledge through BI&A for a successful implementation (Petrini & Pozzebon, 2009; Zameer et al. 2022).

In fact, despite the increasing popularity of BI-tools within organisations, many implementations fail to achieve their intended success (Ain et al. 2019). Consequently, IS researchers have explored factors that are important for a successful IS implementation across various information systems and contexts. The concept of critical success factors (CSF) has therefore been developed and can be defined as "the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organisation" (Rockart, 1978, p.12). Scholars further emphasise the importance of understanding the CSFs that impact the success of BI implementation for the organisation in question (Yeoh & Popovič, 2016). In the context of this study, public value and achieving sustainability takes precedence over competitive performance. Understanding CSFs not only explains implementation success but also aids in measurement and research design framing, an established practice in IS research and even those exploring BI implementation (Ain et al. 2019; Yeoh & Popovič, 2016; Olszak & Ziemba, 2012; Yeoh & Koronios, 2010).

However, there is a significant gap in understanding how organisations can use BI to monitor sustainability practices (Petrini & Pozzebon, 2009). This is also emphasised by Raut et al. (2019) and Zhang et al. (2022) as they mention that there are few research articles that focus on big data analytics (BDA) and environmental aspects. Additionally, there is a lack of research on identifying the necessary capabilities for organisations to achieve sustainable development and integrate these with digital technologies (Feroz & Chiravuri, 2021). Furthermore, in regard to BI adoption, a lot of research has been made in government services (Ain et al. 2019). However, the research is mostly quantitative, and as there is a need for a deeper and more nuanced understanding of BI adoption, qualitative research is motivated (Ain et al. 2019). Specifically, qualitative research allows us to gain deeper insights into how individuals who work with the systems perceive them, offering a richer understanding of the CSFs for implementation.

The literature identifies the significance of utilising BI to enhance the organisation's decision-making and efficiency. Meanwhile, the importance of sustainable initiatives is growing within local governments. Furthermore, although some studies have explored the overlap between BI and sustainability, and the integration of digital technologies in government services, there is still a noticeable lack of research that combines all three research areas together.

## 1.2 Purpose and Aim

The purpose of the research paper is to explore the importance of critical success factors (CSF), as perceived by municipal employees, for implementing business intelligence (BI) tools within municipalities for sustainability initiatives. By examining the intersection of BI adoption and environmental sustainability initiatives in a municipal context, this research

aims to provide insights into how municipalities can implement BI effectively to support their efforts towards environmentally sustainable development. Additionally, the paper aims to contribute to the current information systems discourse in the intersection of BI, environmental sustainability, and municipality in regard to CSFs derived from the literature blended with empirical data from our research.

## 1.3 Research Question

Based on the purpose and aim of the thesis, the research question guiding the study is as follows, *what factors do municipal employees perceive as critical to the successful implementation of BI for environmental sustainability initiatives?*

## 1.4 Delimitations

To enhance the clarity and feasibility of the thesis, some limitations have been defined. Firstly, the aim of the thesis is to develop an understanding of the implementation of business intelligence tools for environmental sustainability initiatives within municipalities, with the help of critical success factors. Therefore, exploring the opinions and reflections made by the responsible employees regarding these tools, making the research more of a human-centric study. Hence, the aim is not to prove the de facto influence of the CSF on implementation, but instead to explore the perceived importance of them from the perspectives of the employees. Therefore, the data collection is focused on the responsible employees supervising the usage of the tool, and no other stakeholders, such as top management or other employees being affected by the implementation. Furthermore, the paper focuses on exploring the environmental aspect of sustainability, and not the social and economic aspects. The study is further limited to the geographical boundaries of Sweden. Since the study is being conducted with a qualitative approach, the data collection will consist of only a limited number of interviews as there is a limited amount of time. Hence, generalisation will be difficult to obtain, as the small sample size cannot be applicable to all Swedish municipalities which might have contextual differences. Further, regarding the qualitative approach, as the empirical material relies on an interpretation of the participants, there is a potential for bias in the data collection, analysis, and interpretation. Bias is also applicable for the participants as their responses might be provided because the participants believe them to align with the expectations of the researchers.

# 2 Literature Review

*This chapter presents the literature review of the proposed research. Firstly, the different concepts are presented in separate sections, such as Business Intelligence, Environmental Sustainability and Business Intelligence, Success Factors with BI adoption within Organisations, Municipality, Sustainability, and Business Intelligence, Success Factors and Challenges with BI adoption for Sustainability within Municipality, and finally Identified Critical Success Factors. Thereafter, the theory Integrated T-O-E is presented separately and lastly combined with the literature for our theoretical framework which is presented in the final section.*

## 2.1 Business Intelligence

According to Chen et al. (2012) business intelligence and big data analytics have become an important field for researchers and practitioners. For the purposes of this paper, the following definition will be used, "a broad category of technologies, applications, and processes for gathering, storing, accessing, and analysing data to help its users make better decisions" (Wixom & Watson, 2010, p.14). This is in line with Sharda et al. (2018) definition of BI, which includes a broad range of concepts such as tools, databases, analytical instruments, methodologies, and applications. BI is often perceived as applications with dashboards to visualise data, yet its scope is much broader than this perception (Wixom & Watson, 2010). According to Wixom and Watson (2010) BI includes gathering, storing, accessing, and visualising data with applications. Additionally, Sharda et al. (2018) explain that the architecture of a BI-system consists of four components, namely data warehouse, business analytics (BA), business process management and user interface.

BA includes different tools for manipulating, mining, and analysing the data in the data warehouse (Sharda et al. 2018). Zaamer et al. (2022) claim that BA facilitates organisations in strategies and decision-making processes. As stated by Ashrafi et al. (2019) BA capabilities affect the organisation's ability to increase the quality of information and innovation, and enables managers to understand the businesses and identify threats and opportunities. Chatterjee et al. (2024) underscore that BA capabilities boost an organisation's ability to make better decisions and improve processes. Big data analytics (BDA) has the same principle as BA but involves analysing a larger set of data (Sharda et al. 2018). In today's digital landscape, the expansion of digital technologies results in the generation of vast amounts of data, commonly referred to as "big data" (Sharda et al. 2018). BA and big data create significant opportunities for organisations to transform data into information (Gillon et al. 2014; Shi et al. 2023).

According to Sharma et al. (2022) there are three types of BA, namely descriptive, predictive, and prescriptive. Additionally, Appelbaum et al (2017) demonstrate that by leveraging these three types of analytics, decision-makers can address the following questions, what has happened (descriptive analytics), what will happen (predictive analytics), and what is the best solution (prescriptive analytics). Sharma et al. (2022) explain that descriptive analytics uses historical data to provide decision-makers a comprehensive overview of what has occurred. Descriptive analytics is the most common of the three types of analytics, and organisations

use it for monitoring important information (Appelbaum et al. 2017). Predictive analytics utilises historical data but also applies artificial intelligence or machine learning to predict the future (Sharma et al. 2022). Furthermore, according to Sharma et al. (2022) organisations use it to reduce risks, enhance operations and increase revenue. Prescriptive analytics uses the data from descriptive and predictive analytics to provide suggestions of what should be done, and in addressing future problems (Appelbaum et al. 2017; Sharma et al. 2022).

Furthermore, the usage of BI in organisations can be divided into three targets: few applications, BI infrastructure, and organisation transformation, as can be seen in Table 2.1 (Wixom & Watson, 2010). The first level, few applications, involves an organisation's strategic vision that only affects the business unit need and the scope is only at the business unit (Wixom & Watson, 2010). The level of commitment and required resources is often low to medium and the BI-system has a limited impact on employees that use the application according to the authors. The second level, BI infrastructure, the strategic vision affects the entire organisation-wide resource, and the level of commitment and required resources is high according to the authors. Additionally, it affects the people in the organisation because processes are more analytical, resulting in fact-based decision-making (Wixom & Watson, 2010). The third level, organisation transformation, fundamentally changes how an organisation is run, requires a new business model and the scope is organisation wide (Wixom & Watson, 2010). Furthermore, the level of commitment and required resources are very high, at the same time as the usage of BI changes the culture, jobs, and processes within the organisation (Wixom & Watson, 2010).

**Table 2.1:** Targets for BI Usage within Organisations (Wixom & Watson, 2010)

| | **Few applications** | **BI infrastructure** | **Organisational transformation** |
|---|---|---|---|
| **Strategic vision** | Satisfy business unit needs | Provide organisation-wide resource | Fundamental change how business is run |
| **Scope** | Business unit | Organisation wide | Organisation wide |
| **Level of commitment** | Low to medium | High | Very high |
| **Required resources** | Low to medium | High | Very high |
| **Impact on people and processes** | Limited to people that use application | Makes jobs and processes more analytical | Fundamentally changes people's jobs, processes, and culture |

## 2.2 Environmental Sustainability and Business Intelligence

The concept of sustainability is not new, still there is a lack of a consistent definition of sustainability in the literature (Moore et al. 2017). In the context of this paper, sustainability will be defined as meeting "the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, s.16). Furthermore, sustainability integrates the three dimensions, environment, society, and economics (Kuhlman & Farrington, 2010). These dimensions originate from the Triple Bottom Line introduced by Elkington in 1994 (Kuhlman & Farrington, 2010), which extends the focus beyond profit (economic) to

include care for the planet (environmental) and social well-being (social) (Kuhlman & Farrington, 2010). Consequently, contemporary sustainable development entails integrating these three dimensions (Goodland, 1995).

The sustainable development goals (SDGs) were developed by the United Nations for the purpose of achieving sustainable development around the world, with the mission to end poverty and protect the planet by 2030 (UNDP, n.d.). The SDGs consist of 17 different goals where they balance the three dimensions of sustainability (UNDP, n.d.). The environmental dimension of sustainable development in Agenda 2030 is defined as "to protect the planet from degradation, including through sustainable consumption and production, sustainably managing its natural resources and taking urgent action on climate change, so that it can support the needs of the present and future generations" (UN General Assembly, 2015). Furthermore, the environmental aspect mainly involves four human activities, namely using renewable resources, using non-renewable resources, managing pollution, and handling waste (Goodland, 1995).

To achieve environmental sustainability, information systems (IS) can be utilised (Melville, 2010). Specifically, IS plays a vital role in improving an organisation's productivity and enhancing an organisation's work by addressing environmental challenges as stated by Watson et al. (2010). Sustainability and IS integration have been classified into the two main areas: green IT and green IS (Shi et al. 2023; Chen & Roberts, 2023). These practices help organisations meet sustainability goals (Chen & Roberts, 2023; Loeser et al. 2017). Green IT involves minimising the negative environmental impacts of IS (Shi et al. 2023) and the practice has often more of an incremental nature (Chen & Roberts, 2023). Green IT is also more restricted to an organisation's IT function (Chen & Roberts, 2023; Loeser et al. 2017) and is more often used in short-term projects (Chen & Roberts, 2023). Meanwhile, green IS involves utilising IS to improve the environment and is more radical in nature (Chen & Roberts, 2023; Loeser et al. 2017). Instead of being restricted to a certain function, green IS goes beyond this function and has therefore more of a holistic span (Chen & Roberts, 2023; Loeser et al. 2017). Additionally, green IS is oriented towards long-term solutions and has often a broader impact (Chen & Roberts, 2023). Therefore, green IS holds greater implications for reaching sustainability goals (Chen & Roberts, 2023) and is the practice more relevant for the paper. The definition used for green IS in this paper is based on the interpretation of Loeser et al. (2017, p. 506) "investments in IS and its deployment, use and management in order to minimise the negative environmental impacts of IT, business operations and end-users' products and services". In conclusion, green IS assists organisations in reaching their environmental goals and can result in cost savings, enhanced corporate reputation, and improved green innovation capabilities (Loeser et al. 2017).

In the context of utilising green IS for sustainability, business intelligence (BI) tools emerge as beneficial tools in gathering and analysing information related to an organisation's sustainability efforts (Petrini & Pozzebon, 2009). With the utilisation of BI-tools, members in the organisations can efficiently identify environmental issues and areas of development (Shi et al. 2023). For example, visualisation of data increases the visibility of sustainability metrics and facilitates members to reflect on sustainability performance (Shi et al. 2023). Cheng et al. (2023) also claim that if an organisation has the capability to analyse big data skilfully, it results in improving the sustainability performance. This is also emphasised by Muntean (2018) who claims that BI-tools improve gathering and analysis of environmental data. Hence, when BI-tools are employed to track, analyse, and improve sustainability metrics, they align with the principles of Green IS.

## 2.3 Success Factors with BI Adoption within Organisations

Today it is increasingly essential for organisations to invest in BI as well as the environment (Zaamer et al. 2022). Specifically, if an organisation invests and implements in BI&A it boosts the data-driven culture which results in opportunities for scanning the environment and areas of development (Zaamer et al. 2022). Thereupon, it is important to consider a number of aspects when it comes to implementing the BI-tools. When looking at the broader aspects that are important for BI implementation, organisational factors such as allocation of resources, as well as IS-related factors are mentioned as most important in many studies in the literature review conducted by Ain et al. (2019).

Hence, when integrating sustainability into BI-systems, firms must not overlook the significance of their organisational context (Petrini & Pozzebon, 2009). The organisational capabilities to leverage BI&A are often low in regard to management, governance, skills, and human resources, which results in implementation challenges, hindering the adoption (Gillon et al. 2014). Furthermore, to successfully utilise the value of data, organisations must adopt an innovation-oriented approach and data-driven culture (Zaamer et al. 2022). Therefore, it is important to educate the employees of the organisations that need to be aligned with the BDA adoption and sustainability according to Raut et al. (2019). One CSF is that management should be committed and supportive (Goede, 2021; Sharda et al. 2018; Yeoh & Popovič, 2016; Raut et al. 2019). Sharda et al. (2018) further explain that the executives must be motivated, as without their sponsorship, a successful implementation will be challenging. This is similar to the CSF business-centric championship described by Yeoh and Popovič (2016), which requires the team to include a person who understands both business and technology, can anticipate challenges, and drive the efforts. Another CSF is alignment between IT strategy and business (Sharda et al. 2018; Yeoh & Popovič, 2016). According to Sharda et al. (2018) alignment is important to ensure that the BI supports the business strategy and analytics. Furthermore, there needs to be a good alignment between vision and strategy (Sharda et al. 2018; Yeoh & Popovič, 2016). According to Yeoh and Popovič (2016) alignment between strategy and BI-system enhances the likelihood for successful implementation. In contrast, Goede (2021) argues that strongly aligning information systems with business objectives is not as important as often portrayed, because it primarily reflects the narrow perspectives of a small group of users, decreasing the diversity of the system and its use. Another essential CSF is that the organisation should engage in a fact-based, decision-making culture instead of being intuition-driven (Sharda et al. 2018). Furthermore, the BI team needs to be balanced and qualitative (Goede, 2021; Yeoh & Popovič, 2016). According to Yeoh and Popovič (2016) a successful implementation of BI-systems is when the team consists of competent staff with both business and technical skills. Another CSF is that the development of BI-systems must be business-driven and iterative (Yeoh & Popovič, 2016). Yeoh and Popovič (2016) also present user-oriented change management, which is that the users should be involved throughout the implementation in order to meet their requirements. This is further discussed by Goede (2021), who declares that lack of user involvement is often a cause of failure in the implementation of BI-systems.

Furthermore, regarding the technology oriented aspects, there are several CSFs when implementing BI-systems (Goede, 2021; Sharda et al. 2018; Yeoh & Popovič, 2016). The organisation must have a strong data infrastructure when implementing a BI-system (Goede, 2021; Sharda et al. 2018; Yeoh & Popovič, 2016). As emphasised by Sharda et al. (2018) the data warehouses must have a good infrastructure to successfully analyse the data. The infrastructure is important for organising and maintaining data across the organisation which

results in accurate, consistent, and reliable data according to Yeoh and Popovič (2016). This leads onto another CSF, which is data quality and integrity (Yeoh & Popovič, 2016). Data quality and integrity is important because it will lead to effective and better decision-making, because the organisation needs to ensure the BI-system is useful and reliable (Yeoh & Popovič, 2016).

## 2.4 Municipality, Sustainability, and Business Intelligence

In the era of digital technologies, the concept of digital governance has risen, where governments utilise IT resources to facilitate the provision of services and to create public value for the citizens of the municipalities (Chen, 2017; Pang et al. 2014). Similarly, SKL (2019) claims that digitization and digital governance offer the public sector opportunities for greater efficiency and innovation as it enables public sector employees to access current information, allowing them to focus on providing the best service to citizens (SKL, 2019). Furthermore, it is established that the tools and technologies are available for local government. However, the challenge resides in governments' ability to effectively implement different strategic digital governance initiatives (Chen, 2017). Doing so they have to cultivate organisational capabilities, such as the collective skills, competencies, processes, and resources within the public sector (Pang et al. 2014). Additionally, the tasks related to digitalisation and innovation must be addressed locally within each municipality (SKL, 2019), meaning that the efforts based on the organisational capabilities made by separate municipalities can differ. Carlsson et al. (2023) note that the public sector allocates less funding to digitalisation compared to other service sectors. In fact, according to SKL (2019), municipalities face a challenge in balancing their routine operations with the allocation of resources for digitalisation and innovation. Additionally, the money needs to be wisely invested as the resources are funded by taxpayers' money, making it more imperative that the decisions taken within municipalities are well grounded (SKR, 2023b). Hence, the allocation of resources directly and indirectly connects to the creation of public value, an aspect that is unique for the public sector. Especially as private organisations assist people as customers and work for profit, while public organisations assist people as constituents (citizens) and work for sustainable economic growth and accounts for public value (Twizeyimana & Andersson, 2019).

Moreover, among the responsibilities of local government, it has now become increasingly important that government institutions work with sustainability initiatives (Yasmeen et al. 2020; Krantz & Gustavsson, 2021; Zhang, 2022; Estevez et al. 2013). Municipalities need to be able to translate the 2030 Agenda's SDGs (Sustainable Development Goals) into actionable strategies (Krantz & Gustafsson, 2021). SKR (2024) establishes that Agenda 2030 cannot be treated as a secondary concern for the municipalities, but instead as an integrated dimension of municipalities' governance and management systems. The role of municipalities in addressing sustainability issues varies but involves both the internal and external aspects of municipal operations (RUS, 2020). Among the external responsibilities is implementing green regulations to cope with environmental challenges and ensuring their enforcement (Yasmeen et al. 2020). For example, as of 2016 the Annual Accounts Act (SFS 1995:1554) declares that Swedish companies are required to prepare a sustainability report. Additionally, corporate sustainability reporting (CSR) has become effective as of this year following the EU mandate that requires large and listed companies to report their social and environmental risks, along with their impact on the planet and its people (European Commission, n.d.).

Government-owned companies are directly bound by these regulations, and even though they are not responsible for enforcing CSR, it is anticipated that municipalities themselves will feel the impact of the revised sustainability reporting standards (PWC, 2023). Furthermore, internally, municipalities need to identify potential sustainability capabilities and necessary data needed to achieve sustainability goals (Zhang et al. 2022). PWC (2023) recommends both the process of tracking the sustainability goals based on associated indicators, as well as reporting a holistic view of municipalities' sustainability efforts.

Facilitating the above mentioned processes, data as well as business intelligence-tools can be used within the municipalities (PWC, 2023; Digg, 2022a). Public sectors and specifically municipalities have opportunities to leverage data for sustainability initiatives, enabling more precise regulations and mechanisms for protecting environmental assets (IBM, 2020; Allam & Dhunny, 2019; Joukhadar et al. 2023; Estevez et al. 2013). According to Digg (2022a), the Swedish Agency for Digital Government, BI&A can assist organisations in understanding their internal operations, as well as the behaviours and needs of citizens and private organisations. In addition, the governance and planning within the public sector can be facilitated with data and with a data-driven approach, as municipalities can use real time data to make more informed decisions (Digg, 2023). As governments generate, collect and also possess a great amount of data, analytics can highly facilitate for governments to gain various insights (Pang et al. 2014). Utilising data for governance decisions has proven to be efficient, citizen-oriented, and sustainable (Allam & Dhunny, 2019). Similarly, BA can be used in governments to transform government processes, empower citizens, improve transparency, participation, and equality (Chen et al. 2012). Currently, some municipalities in Sweden are beginning to utilise technologies like BI for their environmental sustainability initiatives, with most still in the early stages of adoption (Digg, 2022b; Ripgården, 2021). However, within municipalities, business intelligence tools are commonly referred to as "Beslutsstöd", i.e decision support (Digg, 2022b).

## 2.5 Success Factors and Challenges with BI adoption for Sustainability within Municipality

The distinction of working with implementing technology solutions within the public sector contribute to distinct challenges, and therefore require customised strategies to handle this particular context (Caudle et al. 1991). Mainly the challenges revolve around the organisational dimension, as well as some connected to the environmental dimension. In regard to external environmental challenges, this mainly involves political support, as well as lack of funding for the projects (Keskitalo & Liljenfeldt, 2012; Kranz & Gustafsson, 2021). Likewise, Caudle et al. (1991) emphasise the impact of politics and bureaucratic red tape within government. For the organisational dimension, the challenges with working with sustainability goals are inherent complexity of sustainability integration, capacity limitations, inclusivity, cross-sector coordination, and management of ongoing efforts and policies (Kranz & Gustafsson, 2021; Keskitalo & Liljenfeldt, 2012). The challenges of technology adoption include slow mobilisation, core rigidities, service-based silos, premature solutioning, and failure to align investment with government priorities, all of which further aggravate the challenges with handling these complex processes (Joukhadar et al. 2023). In addition, the municipal silos cause that different departments within the same municipality have different solutions and IT-systems (Digg, 2022a), making it challenging to cooperate with each other. In addition, Joukhadar et al. (2023) mention that digital innovation within the public sector

involves collaboration with multiple government stakeholders, which leads to complex decision-making processes. Furthermore, concerning governance, the initiation of IS implementation in the public sector is typically initiated middle-up compared to the private sector, leading to different technological solutions in different departments (Caudle et al. 1991; Digg, 2022). Additional challenges include inconsistent digital maturity and non-digital mindset for the employees (Joukhadar et al. 2023). Similarly, Sharda et al. (2018, p.46) stress the significance of user skill sets and organisational culture as primary considerations in BI initiatives. This is emphasised by OECD (2019) claiming that there is a need for cultural changes to encourage more digital experimentation and innovation, and to welcome new ideas and talent in Sweden's public sector.

Based on the context of BI adoption for sustainability within local government, the aspects of technology, environment, and organisation have been considered in the literature and provide various factors to be considered when implementing technology. Regarding the technological aspect, security, IT-architecture, interoperability, and data-driven agility (appropriate use of data) are identified as important factors for implementation (Jonathan, 2020). Ziemba (2021) further emphasises the importance of the quality of an ICT, which includes functionality, reliability, usability, efficiency, maintainability, and portability of the tool. Moreover, for the organisational context, change management, organisational culture, business-IT alignment, leadership engagement, and skills development programmes are deemed as important to consider for having a positive impact on implementation (Jonathan, 2020; Ziemba, 2021). Furthermore, Krantz and Gustafsson (2021) claim that an integrated, cross-sector, and collaborative effort is required for successful implementation of the sustainability goals. Likewise, Zhang et al. (2022) demonstrates that cooperation between BDA practitioners and sustainability experts is necessary, and OECD (2019) highlights that collaboration between all government departments is needed. Finally, the environmental factors are related to funding, political stability and backing, citizen participation, regulatory frameworks, and quality of national information infrastructure (Jonathan, 2020; OECD, 2019; Ziemba, 2021). Notably, the configuration of organisational variables is deemed more critical than the complexity of the IT solutions (Jonathan, 2020), highlighting the importance of comprehending the context around the tools compared to their mere presence.

## 2.6 Identified Critical Success Factors

From the extensive literature review above, diverse critical success factors have been identified related to technology implementation in the context of municipality, sustainability, and business intelligence. As for Rockart's (1978, p.12) definition of critical success factors, i.e. "the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organisation", and in the context that municipalities strive towards providing public value, not a competitive performance, the below mentioned factors in Table 2.2 shall ensure a successful implementation for the municipalities.

**Table 2.2:** Critical Success Factors Derived from Literature Review

| CSF | Description | References |
|---|---|---|
| Data architecture and infrastructure | How data is managed, as well as design and organisation of components in the system. | Goede, 2021; Jonathan, 2020; Sharda et al. 2018; Yeoh & Popovič, 2016; |
| Data quality and integrity | Functionality, reliability, usability, efficiency, maintainability, and portability. Unchanged and uncorrupted data. | Yeoh & Popovič, 2016; Ziemba, 2021 |
| Data security and compliance | Data protection practices, recognising cyber-threats, and having countermeasures. | Jonathan, 2020 |
| Interoperability and standards within public sector | Compatibility between systems, facilitating communication. Utilising standards to enhance collaboration between public organisations. | Jonathan, 2020 |
| Cooperation cross-sector | Unified direction and cooperation with sustainability issues over organisational silos. | Krantz & Gustafsson, 2021; Joukhadar et al. 2023; OECD 2019 |
| BI and sustainability experts | Consultants helping municipalities with technical and sustainability dimensions, respectively. | Zhang et al. 2022 |
| Top management support | Receiving the motivation and guidance from top management for implementing. | Goede, 2021; Jonathan, 2020; Raut et al. 2019; Sharda et al. 2018; Yeoh & Popovič, 2016; Ziemba, 2021 |
| Organisational culture | Norms, values, structure within the municipality. Having a fact-based decision-making culture. | Sharda et al. 2018; Jonathan, 2020; Zaamer et al. 2022; Ziemba, 2021 |
| Balanced and qualitative team | Competent BI team with appropriate business and technical skills. | Goede, 2021; Yeoh & Popovič, 2016 |
| Change management | Addressing the needs and experiences of those being affected by the system. | Goede; 2021; Jonathan, 2020; Yeoh & Popovič, 2016; Ziemba, 2021 |
| Alignment IT-business | Align BI strategy with business objectives (technology and business needs to be aligned). | Sharda et al. 2018; Yeoh & Popovič, 2016; Jonathan, 2020 |

| | | |
|---|---|---|
| Funding | Financial resources allocated for working with the implementation. | Jonathan, 2020; Ziemba, 2021; Keskitalo & Liljenfeldt, 2012 |
| Political powers | Political stability and influence affecting the direction of scope and allocation of resources | Jonathan, 2020; Krantz & Gustafsson, 2021 |
| Citizen participation | Engagement and involvement of citizens during implementation and of finalised service. | Jonathan, 2020 |
| Regulatory frameworks | Rules, guidance and laws regulating the municipalities. | Jonathan, 2020 |
| Quality of national information infrastructure | Sufficient telecommunications and landlines nationally. | Jonathan, 2020 |

## 2.7 Integrated Technology-Organisation-Environment

The Technology-Organisation-Environment (T-O-E) framework is widely used within the field of information systems and was proposed by Tornatzsky and Fleisher in 1990, to understand how different factors influence organisations during the adoption of a technology (Awa et al. 2017). For the paper, the definition of adoption in the context of BI involves the de facto adoption, initial BI-system usage, users' intention and satisfaction, as derived from Ain et al. (2019). The term "implementation" will be used interchangeably with "adoption".

Furthermore, the framework Integrated Technology-Organisation-Environment was proposed by Awa et al (2017) as a complement and extension of the original T-O-E framework with the addition of the concepts task and individual, derived from the frameworks TTF (Task-Technology-Fit) and UTAUT (Unified Theory of Acceptance and Use of Technology). As the latter theories were often used combined with T-O-E in research within the IS field, Awa et al. (2017) found that there was a need for integrating these. Through the addition of the concepts individual and task, a more nuanced understanding of technology adoption is provided (Awa et al. 2017). The Integrated T-O-E explains the implementation and usage of new technologies within an organisation through the influence of the factors Technology, Organisation, Environment, Task, and Individual (Awa et al. 2017). As stated by Awa et al. (2017) the T-O-E framework is more of a high-level theoretical framework, as it facilitates the understanding of adoption behaviour for high-level attributes. Instead of focusing on the individual level factors, the organisational level factors are of value for T-O-E. However, when adding the individual and task context, the theory is fitting for the paper in order to understand the experience of implementing BI. In conclusion, utilising the Integrated T-O-E framework helps the paper identify important factors from the perspective of employees in implementing BI in municipalities for environmental sustainability purposes.

### 2.7.1 Technology context

The first context within the Integrated T-O-E framework is technology, addressing how easily users can control and adapt to new systems (Awa et al. 2017). Additionally, according to Gangwar et al. (2014) the technology context refers to the factors that impact an individual, organisation, and industry's adoption of technology. This includes how well the system fits in with existing processes, its benefits compared to other options, and its security and reliability (Awa et al. 2017). According to Awa et al. (2017) the framework focuses on three key factors within the technology context that have an influence on implementation: how easy the system is to use (perceived simplicity), how well it works with existing tools (compatibility), and how valuable it is perceived to be (perceived values). The technology context in this paper facilitates in understanding the implementation of business intelligence-tools for environmental sustainability initiatives within municipalities. As using BI-tools for sustainability has proven to be beneficial according to many scholars (Cheng et al. 2023; Petrini & Pozzebon, 2009; Ramanathan et al. 2017; Raut et al. 2019; Shi et al. 2023; Zaamer et al. 2022; Zhang et al. 2022).

### 2.7.2 Organisational context

The second context within the Integrated T-O-E framework is organisation. According to Puklavec et al. (2018) the organisational context refers to the formal and informal organisational factors for communication, control, innovation, and resources that affect the adoption. Awa et al. (2017) further describe that the factors focus on the availability of internal resources, social influences, organisational mission, and facilitating conditions. As well as aspects like company culture, human resource quality, and communication channels (Awa et al. 2017). Furthermore, the organisational context focuses on three key areas, such as top management support (TMS), enterprise size and business operations scope (Awa et al. 2017). TMS involves the encouragement provided by top management for technology adoption within the organisation, as TMS's decisions and behaviours significantly influence technology adoption through establishment of norms, values, and vision (Awa et al. 2017). Furthermore, the size of the company as well as the scope of business influences and determines the possibility of adopting new technologies according to Awa et al. (2017). For the paper, the organisation context facilitates in understanding the unique dimension of Swedish municipalities that is distinct to private organisations (Caudle et al. 1991), and in which the implementation takes place.

### 2.7.3 Environmental context

The third context within the Integrated T-O-E framework is environment. This context refers to the domain in which the organisation operates and factors that influence the organisation's industry, stated by Salwani et al. (2009). Awa et al. (2017) conclude that the environmental context consists of two different factors, specifically normative pressure and mimetic pressure. Normative pressure stems from demands by trading partners and customers, legal frameworks, and government agencies, all of which influences decisions related to adoption (Awa et al. 2017). Additionally, according to Awa et al. (2017) interorganisational influences like grants and technical assistance also play crucial roles, as ignoring these factors can result in penalties and missed business opportunities. In contrast, mimetic pressure stems from the fact that organisations consciously observe other organisations and mimic their actions to remain competitive (Awa et al. 2017). In the context of municipalities, staying competitive is

not as relevant. However, municipalities might still adopt similar strategies and technologies as their peer municipalities when these have been proved successful. Therefore, the environmental context facilitates in understanding the circumstances surrounding Swedish municipalities, as these once again are different compared to private organisations.

### *2.7.4 Individual context*

The fourth context in the Integrated T-O-E framework is the individual context. As emphasised by Awa et al. (2017), organisations are influenced by the cognitive assumptions of its decision-makers, which shape the organisations' strategic and tactical focus. Hence, the adoption of enterprise-level innovations is heavily influenced by the attitudes, perceptions, motivations, and individual differences of decision-makers. Furthermore, the authors declare that the integrated framework includes two factors for the individual context, namely social influence and hedonistic drives. Social influence is about subjective norms and revolves around the enhancement of an individual's image and social status. Hedonistic drives on the other hand, revolves around an individual's calculations of alternative options and then investment in the one most gratifying. As initiatives within municipalities often are initiated middle-up (Caudle et al. 1991; Digg, 2022a), the individual's engagement within municipalities are important concerning implementation within municipalities. For the paper the individual context will facilitate understanding the social and individual aspects that surround the employees of the municipalities.

### *2.7.5 Task context*

Lastly, the fifth context in the Integrated T-O-E framework is the task context. According to Awa et al. (2017) the dimension of task demonstrates how technology aligns with the complexity and interdependencies of tasks. Matching task demands with technology capabilities is found to positively impact the adoption of innovations (Awa et al. 2017). When technology falls short of task requirements, it is less likely to be adopted, as it may not contribute to gaining a competitive edge (Awa et al. 2017). The authors specifically posit two factors for the task context task, precisely task complexity and task interdependence. Task complexity refers to the intricacy involved in completing tasks and understanding their relationships. Task interdependence, on the other hand, measures the degree of connectivity between tasks and organisational units. As there is a complexity in working with tasks related to environmental sustainability (Piotrowicz & Cuthbertson, 2009; Gholami et al. 2016), might this affect the use of technologies. Additionally, while municipalities often need to cooperate cross-sector regarding sustainability tasks (Krantz & Gustafsson, 2021), might this create an interdependence of tasks and motivate the use of a sophisticated technology, such as BI-tools. Consequently, the task context will facilitate understanding the environmental sustainability tasks and operations that the municipalities want to accomplish with the help of the BI-tools.

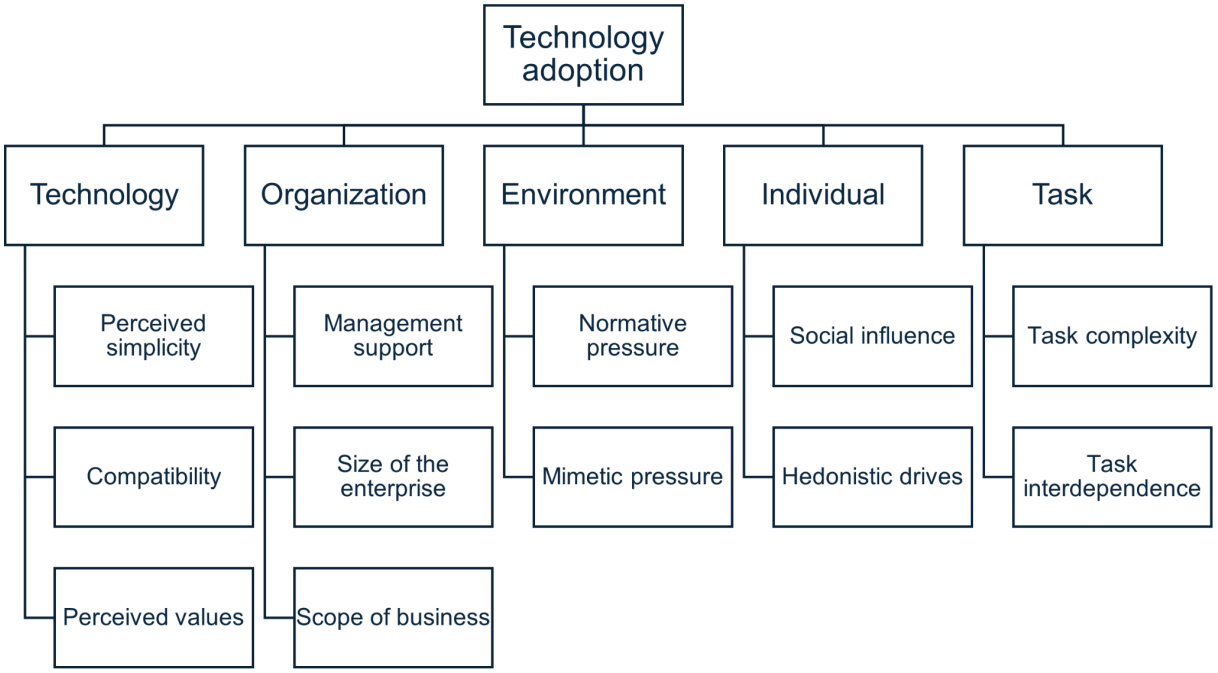


**Figure 2.1:** Framework Integrated Technology-Organisation-Environment (Awa et al. 2017)

The Integrated T-O-E framework has been declared to be adaptable, as it enables the inclusion of other suitable factors depending on the context of a specific technology (Lautenbach et al. 2017; Awa et al. 2017). For example, the T-O-E framework has been used in previous empirical studies to understand BI&A adoption, such as risks involved in adoption and determinants for big data analytics adoption (Ramanathan et al. 2017; Stjepić et al. 2021; Lautenbach et al. 2017; Puklavec et al. 2018). Because of the adaptability as well as the extent usage of T-O-E within the IS field, the theory is deemed to be of value for the interpretation of the empirical material in the thesis.

Specifically, through the usage of the theoretical framework Integrated T-O-E, the adoption and implementation of BI-tools within municipalities will be studied. Furthermore, the context for where the implementation of the technology is taking place affects a successful adoption and requires that different factors are considered (Awa et al. 2017). To uncover the experience of implementing BI for environmental sustainability in the context of municipalities, these specific factors need to be addressed in this specific context. There is therefore a need for further research to capture these determinant factors for technology adoption regarding business intelligence in both a municipal and sustainability context.

## 2.8 Theoretical Framework

To create a comprehensive theoretical framework to guide the interpretation and analysis of our empirical data, we integrated the identified CSFs from our literature review (see Table 2.2) with the Integrated T-O-E framework. Hence, together with the established factors from the theory Integrated T-O-E, the identified critical success factors (see Table 2.2) were combined into the finalised list of CSFs (see Table 2.3). The theoretical framework is used to interpret and analyse the results of the empirical material with the aim to understand the

experience of implementing business intelligence for environmental sustainability within municipalities in Sweden. The declared factors are specific for the implementation of business intelligence tools for environmental sustainability initiatives within municipalities and will be used as qualitative measurements to explore the success of implementing BI-tools within our targeted municipal context. Specifically, the CSFs will be used as a basis for gathering, as well as analysing the empirical material.

**Table 2.3:** Critical Success Factors Integrated with Integrated T-O-E Framework

| **T-O-E concept** | **CSF** | **References** |
|---|---|---|
| Technological | Perceived simplicity | Awa et al. 2017 |
| | Compatibility and interoperability | Awa et al. 2017; Jonathan, 2020 |
| | Perceived values | Awa et al. 2017 |
| | Data architecture and infrastructure | Jonathan, 2020; Sharda et al. 2018; Yeoh & Popovič, 2016; Goede, 2021 |
| | Data quality and integrity | Jonathan, 2020; Yeoh & Popovič, 2016; Ziemba, 2021 |
| | Data security and compliance | Jonathan, 2020 |
| Organisational | Cooperation cross-sector | Joukhadar et al. 2023; Keskitalo & Liljenfeldt, 2012; Krantz & Gustafsson, 2021 |
| | Top management support (TMS) | Awa et al. 2017; Goede, 2021; Jonathan, 2020; Raut et al. 2019; Sharda et al. 2018; Yeoh & Popovič, 2016; Ziemba, 2021 |
| | Size of municipality | Awa et al. 2017 |
| | Organisational culture | Sharda et al. 2018; Jonathan, 2020; Zaamer et al. 2022; Ziemba, 2021 |
| | Balanced, qualitative team and experts | Goede, 2021; Yeoh & Popovič, 2016; Zhang et al. 2022 |

| | | |
|---|---|---|
| | Change management | Goede; 2021; Jonathan, 2020; Yeoh & Popovič, 2016; Ziemba, 2021 |
| | Scope and alignment IT-business | Awa et al. 2017; Sharda et al. 2018; Yeoh & Popovič, 2016; Jonathan, 2020 |
| Environmental | Funding (normative) | Awa et al. 2017; Jonathan, 2020; Ziemba, 2021 |
| | Political powers (normative) | Awa et al. 2017; Jonathan, 2020 |
| | Citizen participation (normative) | Awa et al. 2017; Jonathan, 2020 |
| | Regulatory frameworks (normative) | Awa et al. 2017; Jonathan, 2020 |
| | Quality of national information infrastructure (normative) | Awa et al. 2017; Jonathan, 2020 |
| | Mimetic pressure | Awa et al. 2017 |
| Individual | Social influence (individual motivation & middle-up initiated) | Awa et al. 2017; Caudle et al. 1991; Digg, 2022; Goede 2021; Sharda et al. 2018; Yeoh & Popovič, 2016 |
| | Hedonistic drive | Awa et al. 2017 |
| Task | Task complexity | Awa et al. 2017 |
| | Task interdependence | Awa et al. 2017 |

# 3 Research Design

*This chapter presents the research design of the proposed research. Firstly, the research philosophy of the thesis is presented, followed by the research approach. Secondly, the search strategy for the literature collection is presented. Thirdly, the data collection methods and the data analysis methods are presented. Lastly, the chapter ends with considering the underlying ethical considerations, as well as the scientific quality of the research paper.*

## 3.1 Research Philosophy

The research philosophy used when conducting research affects how the researcher understands and observes the world (Lee, 2004) as well as how knowledge is acquired (Hassan & Mingers, 2018). Additionally, it has been argued that the field of IS research is not about the artefacts of information technology alone, but the context in which these artefacts exist (Lee, 2004). Hence, establishing the research philosophy for this thesis is important in order to understand its content. The elements of research philosophy are ontology and epistemology and together they form a paradigm for the thesis' constellation of beliefs, values and techniques (Hassan & Mingers, 2018). The ontological worldview (Lee, 2004) used for this thesis is based on the constructionist perspective, which posits reality as socially constructed and subjective where the context of IS is important (Goldkuhl, 2012). Related to this thesis, this means understanding the adoption of BI in municipalities for environmental sustainability and what meanings are associated with the different concepts comprising the intersection between municipality, sustainability, and BI. Understanding the concepts of BI and sustainability is important and can differ from municipality to municipality, as well depending on each respondent being interviewed.

Secondly, epistemology is the theory of knowledge and implies how we acquire knowledge (Hassan & Mingers, 2018), hence it implies what theoretical perspectives to use when conducting research (Hassan, Mingers & Stahl, 2018). As this research study is undertaking a qualitative approach, where employees of municipalities are interviewed with the aim to gain a deeper understanding of their thoughts regarding a certain subject, the interpretivist approach was the one that was being used as a paradigm for the study. In the context of our research, interpretivism facilitated in understanding that people and artefacts differ from the physical reality and further that human action involves attaching meaning to said artefacts, which makes them more complex to study (Lee, 1991). As this study focuses on obtaining an understanding of the interaction between employees, organisation, and the technological artefact they are utilising, interpretivism facilitated when seeking to understand the meaning that had been associated with the field of study for the thesis.

In comparison, the contrast paradigm positivism separates meanings from facts, whereas this study regards meanings as what constitute facts, which corresponds more to interpretivism (Recker, 2013). Additionally, the study interpreted individuals as different beings with their own perspective and position on one and the same phenomena, and that these different insights together will contribute to knowledge for the thesis. Hence, as positivism is not sufficient to understand the social reality within IS, interpretivism is a better choice (Lee, 1991). Regarding another paradigm pragmatism, this paradigm focuses on constructive

knowledge which can be used for action, while interpretivism focuses on data from qualitative research of interest to investigate (Goldkuhl, 2012). The latter was deemed to be more appropriate in comparison, as it prioritises the exploration of meanings, interpretations, and perspectives, which are essential for capturing the complexities of our research topic within its context.

## 3.2 Research Approach

The research question concerns, *"what factors do municipal employees perceive as critical to the successful implementation of BI for environmental sustainability initiatives?"*. As this involved gathering in-depth empirical data to understand how municipalities utilise BI&A in environmental sustainability initiatives, a qualitative method was chosen for the research approach. Additionally, the qualitative method enhanced the exploration of key factors, as it facilitated the inquiry of respondents' perspectives, feelings, and thoughts, which are crucial for understanding the intricacies involved and uncover the emergent meaning that the participants have to clarify a phenomenon from multiple perspectives. Additionally, the research question aims to understand a phenomena in real-life context, which is in line with Recker (2013). Specifically, qualitative research involves looking at "why" and "how" in a certain context (Recker, 2013). Even though the research question of the paper explores "what" factors facilitate a successful implementation, a foundational understanding is first obtained through exploring "why" municipalities decided to adopt BI&A for environmental sustainability initiatives and "how" the employees experienced the implementation of BI process. This further indicates the motivation to conduct the research in the contextual setting where the phenomena occur, which is one of the principles of qualitative research (Recker, 2013). Additionally, as the study explores key factors with the help of the Integrated T-O-E framework with the aim to further contribute to this specific discourse, the qualitative method facilitates because of its exploratory and holistic nature (Recker, 2013).

However, qualitative research also presents some challenges, particularly in terms of generalizability and reliability (Recker, 2013). Qualitative research uses smaller, more contextualised samples, making it harder to generalise or replicate the findings compared to quantitative research (Recker, 2013). Consequently, as the study has a sample size of five municipalities, the results might not be applicable to all other municipalities in Sweden. Furthermore, the data is subjective and therefore it might have issues with reliability (Recker, 2013). This was considered and handled in a separate section. Despite these challenges the qualitative method was considered a more appropriate choice, because the primary objective of the study was to gain in-depth knowledge about how municipalities adopt BI&A for environmental sustainability initiatives from the employee's perspective.

## 3.3 Search Strategy

A literature review was conducted using the scholarly databases accessed through Lund University Library's website. To find corresponding databases to the information systems field, we searched by the subject Business and Economics and then Information Systems. Several databases were used, among others Emerald, ACM, Elsevier, and Springer. In addition, Web of Science and Google Scholar were used to perform the literature search. When conducting the literature review the following search terms were used: *environmental*

*sustainability*, *green IS*, *business intelligence*, *business analytics*, *local governance*, *public sector*, *municipality*, *government*, *TOE-framework*, and *climate change*. Furthermore, acronyms such as BI and BA were also used when searching. The search terms were used in the identified electronic databases as both simple search strings, as well as with the Boolean operators AND/OR to find information in the selected field of study.

Moreover, the criteria for the literature review are as follows, previous research should primarily be published within the last seven years, i.e., from 2017 onwards, and it should be written in English. Other languages will mostly be excluded as they are not considered relevant or useful for the study. Older research material can be beneficial as this form the foundation for the current discourse in the field, and might fill gaps where there is less studies, however newer research is still prioritised for its relevance and currency. Furthermore, other sources considered to be grey literature are also used in order to explore the contextual concepts of both sustainability and local government within Sweden. For example, IPCC, SKR, and OECD.

When conducting the literature review, the literature search results were evaluated through first reading the abstracts as well as the conclusions. If these were deemed relevant for the thesis, the rest of the article was read. Articles from the senior scholar's list of premier journals were prioritised when conducting the literature review. Additionally, looking at articles' number of citations gave us an indication of the popularity of each article. Furthermore, peer-reviewed articles were also prioritised in the literature search.

The following table (Table 3.1) is based on the concept matrix proposed by Webster and Watson (2002). From the literature review, three main concepts have been identified, each with its own set of detailed sub-concepts.

**Table 3.1:** Concept Matrix for Literature Review

| **Concept** | **Detailed concept** | **Reference** |
|---|---|---|
| Sustainability | Green IS vs Green IT | Chen & Roberts, 2023; Loeser et al. 2017; Shi et al. 2023 |
| | Sustainable development and environmental sustainability | Goodland, 1995; Kuhlman & Farrington, 2010; UNDP, n.d.; UN General Assembly, 2015; WCED, 1987 |
| Business Intelligence | BI | Appelbaum et al. 2017; Ashrafi et al. 2019; Cheng et al. 2023; Gillon et al. 2014; Sharda et al. 2018; Shi et al. 2023; Sharma et al. 2022; Wixom & Watson, 2010; Zaamer et al. 2022; Chatterjee et al. 2024 |

| | | |
|---|---|---|
| | Critical Success Factors for BI implementation | Ain et al. 2019; Goede, 2021; Petrini & Pozzebon, 2009; Raut et al. 2019; Sharda et al. 2018; Yeoh & Popovič 2016; Ziemba, 2021 |
| | BI and sustainability | Cheng et al. 2023; Muntean, 2018; Petrini & Pozzebon, 2009; Ramanathan et al. 2017; Raut et al. 2019; Shi et al. 2023; Zaamer et al. 2022; Zhang et al. 2022 |
| Municipality | Local government and municipality | Digg, 2022a; SKR, 2022; SKR, 2023a; Carlsson et al. 2023; SKL, 2019 |
| | Municipal work for sustainability | Yasmeen et al. 2020; Krantz & Gustavsson, 2021; Zhang, 2022; Estevez et al. 2013 |
| | Technology adoption within government | Pang et al. 2014; Caudle et al. 1991; Chen 2017; SKL, 2019; OECD, 2019 |
| | Opportunities with BI for sustainability within municipality | IBM, 2020; Allam & Dhunny, 2019; Joukhadar et al. 2023; Chen et al. 2012; Ziemba, 2021; Estevez et al. 2013; Krantz & Gustafsson, 2021 |
| | Challenges with technology adoption | Caudle et al. 1991; Joukhadar et al. 2023; Keskitalo & Liljenfeldt, 2012; Kranz & Gustafsson, 2021; OECD, 2019 |
| | Critical success factors for technology implementation | Caudle et al. 1991; Digg, 2022a; Krantz & Gustafsson, 2021; Jonathan, 2020; Ziemba, 2021; Zhang et al. 2022 |
| | Differences government and private organisations | Carlsson et al. 2023; Caudle et al 1991; Twizeyimana & Andersson, 2019 |

## 3.4 Data Collection Methods

The chosen data collection method for this thesis is interviews, which is supported by Recker (2013), who emphasises that interviews are appropriate for qualitative research with an interpretive approach. Additionally, according to Schultze and Avital (2011) qualitative research enhances data quality, resulting in more in-depth insights and improved theorising in the IS research field. Furthermore, the thesis required in-depth information about the respondent's feelings and perception about implementing BI&A regarding environmental sustainability initiatives. Hence, interviews were the suitable choice for collection of data since they are effective at capturing this kind of information (Patton, 2015). Additionally, interviews are the most used method in qualitative research, and it enhances the credibility and has a positive influence on the IS research field (Schultze & Avital, 2011).

### *3.4.1 Selection*

The selection criteria for respondents was that they should work within a municipality in Sweden with implementing BI&A for environmental sustainability initiatives. Some respondents might be in the beginning of the adoption and some respondents might be in the end of this undertaking. The process of the selection of respondents began with emailing SKR for contact details for all the municipalities in Sweden. SKR provided an Excel spreadsheet containing the contact information, including telephone numbers and email addresses for all municipalities in Sweden. Next, the 12 biggest municipalities were contacted according to SCBs (2024) list of the 50 largest municipalities in Sweden. This decision assumed that larger municipalities, with more resources, are more likely to implement BI&A in their environmental sustainability initiatives compared to smaller municipalities. The fact that only big municipalities are participating in the study creates a contextual difference in comparison to smaller municipalities, who might experience the implementation differently. Out of the 12 municipalities that we contacted, the municipalities that answered positively that they worked with BI-tools for environmental sustainability we further contacted. After contacting each municipality, they forwarded us onto an appropriate contact person that met our selection criteria, to whom we further described our research and provided an informed consent form. For confidentiality reasons, the names of the respondents were changed to anonymous representative names. See information of the finalised selected respondents and municipalities in Table 3.2, with information about the size of each municipality derived from SCB (2024), duration of the interview, role of the respondent, and appendix with transcription.

**Table 3.2**: Information of Participants and Municipalities

| Respondent | Municipality | Size of municipality | Time (min) | Role |
|---|---|---|---|---|
| R1 | Jönköping | 146 161 | 51 | Environmental Strategist |
| R2 & R3 | Helsingborg | 151 306 | 60 | Executive of Environmental Strategist, Environmental Strategist |

| | | | | |
|---|---|---|---|---|
| R4 | Lund | 130 288 | 57 | Environmental Strategist |
| R5 | Göteborg | 604 616 | 51 | IT- and Digitalisation Strategist |
| R6 | Malmö | 362 133 | 83 | Environmental Strategist |

### *3.4.2 Interview guide*

An interview guide was created to serve as a guidance, ensuring that the interview will cover the right and necessary information (Patton, 2015). The interview guide can be viewed in Appendix 1. Furthermore, the interview guide is based on the theoretical framework, which consists of the Integrated T-O-E framework with the critical success factors identified from the literature review. Additional questions were added in the beginning and the end to gain insight into some basic information regarding the implementation. Additionally, the interview was semi-structured, where the researchers posed questions from a prepared list and had the flexibility to ask additional questions when needed (Recker, 2013). Therefore, we were able to uncover new and deeper insights about the respondents' perspectives on the implementation of BI&A within municipal environmental sustainability initiatives. This ensured that important information, which might not have been collected through structured interviews, was gathered during the interview.

### *3.4.3 Research Setting*

The research was conducted in the context of Swedish municipalities. Municipalities represent the local level of democracy in Sweden, following the regional level (regions) and the national level (parliament) (SKR, 2021). In Sweden there are 290 municipalities serving the community and citizens in diverse ways (SKR, 2022). Within these municipalities, various departments are responsible for overseeing the services for citizens, including preschool, school, social services, and elderly care, which are mandated by law (SKR, 2023a). Other services are discretionary and decided upon by local politicians, who are directly elected by the municipality's citizens (SKR, 2023a). Today, municipalities also stand responsible for working for sustainable development (Yasmeen et al. 2020; Krantz & Gustavsson, 2021; Zhang, 2022; Estevez et al. 2013), and utilising data can facilitate this work (IBM, 2020; Allam & Dhunny, 2019; Joukhadar et al. 2023). Consequently, some municipalities in Sweden are starting to use technologies such as business intelligence for their environmental sustainability initiatives and a majority are in the earlier stages of their adoption journey (Digg, 2022b; Ripgården, 2021). Hence, we concluded that this research setting would be appropriate and valuable to explore in the intersection with environmental sustainability and business intelligence.

### *3.4.4 Interviews*

Concerning the setting of the interviews (Bell et al. 2019), five interviews were conducted through synchronous online interviewing where a face-to face interaction occurred through a web camera. As established by Bell et al. (2019), there are benefits of conducting interviews

online, such as time savings, flexibility, and convenience, both for the respondents and for the researchers. However, there are some disadvantages with conducting interviews online, for example in terms of connection problems (Bell et al. 2019). Still, this was proven not to be a prevalent issue when conducting the interviews with the respondents. Furthermore, in contrast to these four interviews, the fifth interview was conducted face-to-face as the interview took place in Lund, where the respondent worked and the researchers conducted their research, making this interaction convenient for the purpose of the interview.

When it comes to the actual interviewing, the interviews always commenced with some small talk, as well as expressing our thanks to the respondents for participating. Additional questions could then be raised concerning the participation, or the beforehand provided informed consent form. Thereafter general, foundational questions related to the topic were asked, as proposed by Recker (2013). Doing this, the empirical material received the context needed for the BI implementation within the municipalities, in addition to the reflections in regards to the CSF. After the reflections regarding the CSF had been made, additional general questions were asked once again, winding up the interviews, which were also emphasised by Recker (2013). All of which can be viewed in the interview guide (see Appendix 1). Furthermore, as the study combines inductive and deductive reasoning, leaning towards abductive reasoning, new critical success factors could be identified in the empirical material. These factors were subsequently added to the list (see Table 3.4) and could be integrated into the interview process.

## 3.5 Data Analysis Methods

### *3.5.1 Transcribing*

The interviews were documented on recordings through mobile phones so that the interviewers could be fully concentrated on the interviews themselves, without having to take notes at the same time (Bell et al. 2019). The recordings were then transcribed using the artificial intelligence tool Whisper, which functions by converting audio files into printed text. Whisper is an automatic speech recognition system that has been trained on large datasets, which results in high accuracy and quality (OpenAI, n.d.). To verify the accuracy of the transcriptions, shortly after conducting the interviews we listened to the audio files and reviewed the corresponding texts. As a result, some words and sentences were corrected, removed, or added to correctly correspond with the audio files and maintain the quality of the transcription. Furthermore, to ensure the confidentiality of the respondents, any information that posed a risk in this regard was replaced with an "X" in the transcriptions.

### *3.5.2 Coding*

As emphasised by Recker (2013), deduction tests concepts derived from theory using new empirical data. The study used the theory Integrated T-O-E for the purpose of predefining concepts and to identify patterns in the collected data and draw conclusions based on the literature (Oates et al. 2022). However, as emphasised by Oates et al. (2022) the study was also open to find new themes if these presented themselves. Therefore, the study is leaning more towards abductive reasoning (Patton, 2015), as predefined factors led the research, but

the data collection involved gathering real-world experiences and analysis covered the predefined factors as well as finding new ones. Moreover, after the data was collected, coding was conducted using template analysis, along with colouring and labelling, which are suitable for unstructured qualitative data (Patton, 2015; Recker, 2013). Therefore, a template was created for the analysis based on the theoretical framework, see Table 3.3. This simplified the process of analysing data because it was easier to identify patterns. The coding method described by Recker (2013) involves labelling, tagging, naming, and colouring pieces of data, see Table 3.4 for colour codes. Hence, the researchers independently coded the transcribed material, through colouring and tagging based on the categorisation of colours template (see Table 3.4). Thereafter, the codes were cross-checked to ensure consistency and accuracy, and to mitigate potential biases and error. Furthermore, the template analysis and coding techniques provided an overview of the empirical data and facilitated the process of analysing.

**Table 3.3:** Template for Coding Analysis

| **Row** | **Person** | **Content** | **CSF** |
|---|---|---|---|

**Table 3.4:** Categorisation Colours

| **Colour** | **Category for analysis** | **CSF** |
|---|---|---|
| | Technology | Perceived simplicity, Compatibility and Interoperability, Perceived values, Data architecture and infrastructure, Data quality and integrity, Data security and Compliance |
| | Organisation | Cooperation cross-sector, Top management support, Size of municipality, Organisational culture, Balanced, qualitative team and experts, Change management, Scope and Alignment IT-business |
| | Environment | Funding, Political powers, Citizen participation, Regulatory frameworks, Quality of national information infrastructure, Mimetic pressure |

| | | |
|---|---|---|
| | Individual | Social influence, Hedonistic drive |
| | Task | Task complexity, Task interdependence |
| | New CSF | Available technology, Available time, Governmental support |

## 3.6 Ethical Considerations

There are some ethical issues and challenges when conducting qualitative research. As the data collection for this study was made through interviews, this will specifically be looked upon. The reason for conducting interviews is to gain a personal, interpersonal, and in-depth picture of the participants, which is more intrusive than for example quantitative studies (Patton, 2015). When interviewing the respondents for the study an interaction between the participant and the researchers occurred. Prior to the interview, there was an awareness that this interaction can evoke feelings and thoughts for the participants, and impact participants in ways which beforehand were hard to comprehend or foresee (Patton, 2015). As the purpose of the data collection clearly indicates that the gathering of data is what is of importance, not to affect the participants, it was crucial to keep certain considerations and guidelines in mind when conducting the research (Patton, 2015).

Firstly, the purpose of the study was concisely and clearly declared both before and during the interview, so that the respondents understood and could agree to the participation. Specifically, an informed consent form was sent out to the respondents with email a couple of days before the interview. The informed consent form declared the purpose of the study as well as the possible risks associated with participation. When preparing for the interviews, confidentiality was evaluated so that the ethical and legal dimensions were apparent and followed. In the informed consent form, the participants were informed of their confidentiality in the research, as their names will be disguised (Patton, 2015). The participants were further informed through the informed consent form what information will be asked of them and that their participation could end whenever they wished without questions asked or it affecting the relationship with the interviewers (Wiles, 2012). As the interviews were also to be recorded, consent was asked for in the informed consent form (Wiles, 2012). Finally, during the period of interviews the researchers commenced the interviews with asking for questions regarding the informed consent form, as well as repeating the purpose of the study and explaining once again that the interview was to be recorded.

### *3.6.1 Role of the researchers*

It is said that the greatest risk in social research is both the researchers' as well as the participants' emotional well-being (Wiles, 2012). The researchers therefore paid attention to their own participation and interaction throughout the process, and if risks or challenges arose then these were dealt with in companionship with the co-researcher. Further, the researchers

avoided dwelling into the role of a therapist or judge when conducting the interviews, while at the same time trying to be responsive and supportive to the experiences of the participants (Patton, 2015). However, as the study in question does not deal with heavy issues, this was not a problem for the researchers. Regarding the interaction between the participant and the researchers, the researchers were careful when inquiring about the participants' experiences, not to push too hard for information which can be sensitive for the participants (Patton, 2015). Finally, we recognise the inherent potential for bias when conducting qualitative research, encompassing both the collection of empirical material and the interpretation of data. While we have taken steps to mitigate this bias through the grounding of our analysis in the theoretical framework and in literature, we have remained attentive to the influence of subjective perspectives. In addition, we acknowledge a prior acquaintance between one of the respondents and one of the researchers, to remain transparent about these potential influences and their impact on our findings.

## 3.7 Scientific Quality

When conducting research within social science it is important to use the correct measurements to be able to measure the social constructs sufficiently (Bhattacherjee, 2012). Since this paper is undertaking a qualitative approach, the measurements must be kept in mind so that they are both reliable and valid. Both are needed to make sure that the measurements of a certain construct are adequate (Bhattacherjee, 2012). Firstly, reliability refers to what extent the measures used for this thesis are consistent and dependable, so that you would get the same results depending on the measurement (Bhattacherjee, 2012). This makes sure that the study is repeatable, so that its implications can be further studied and enhanced (Bryman (2016). Quantitative measures can be used to enhance reliability (Bhattacherjee, 2012), however since this was not relevant for the paper other precautions have been taken. For example, ambiguous items were avoided in the measures during data collection (Bhattacherjee, 2012). This means that before the interviews were conducted, clear questions were stated based on our theoretical framework. Additionally, during the interviews the researchers encouraged the participants to voice possible uncertainties that they had prior to the interviews and as the interviews were conducted. Furthermore, the definition of business intelligence was also declared in emails sent to the participants and once again during the interviews, to ensure consensus of the term. The above mentioned precautions made sure that the participants, to a certain extent, could answer and understand the questions equally, which heightened the reliability (Bhattacherjee, 2012; Bryman, 2016).

Further regarding validity, Bryman (2016) divides validity into internal and external. Internal means that there is a connection between observations and theoretical ideas (Bryman, 2016). The researchers used coding, to be able to analyse and interpret the interviews in an adequate way. Through the usage of the existing theory Integrated T-O-E within the field of IS, combined with critical success factors derived from the literature, correspondence between the observations and theoretical ideas was strengthened. The framework used, facilitated that the right questions and therefore the right area was investigated. External validity concerns if the results of the study can be generalised to a group of people beyond the participants taking part in the study (Bryman, 2016). This connects to transferability, i.e. if the findings can be applied to other contexts (Bryman, 2016). As the study includes municipalities that are implementing and using various BI-tools as well as having various experiences with said tools, it can be argued that the study gives an indication of the current discourse regarding environmental sustainability and business intelligence in the context of municipalities.

However, the sample size of six respondents indicate that a general truth cannot be obtained. Although, after the six respondents had been interviewed, patterns could be detected in the collected material and therefore a certain saturation had been reached. Furthermore, ecological validity regards the naturalness of the approach, making sure that the findings are applicable to people's everyday lives (Bryman, 2016). For the study the participants were able to choose their own setting for the interviews, as for virtual or face-to-face. As most of the respondents did not occupy themselves in circumstance to Lund, most of the interviews were conducted virtual and the participants could participate in a setting of their liking and convenience.

Finally, Bryman (2016) touches upon the fact that there are some challenges with a qualitative approach. Firstly, that it deviates towards subjectivity, while the findings rely on the researchers' view who handles the material. This was considered during the process of the research, specifically as the researchers addressed the undertaking of the constructivist and interpretivist perspective. Secondly, that the research is difficult to replicate, as the interviews are semi-structured, and that there are no firmly set procedures to be followed, with a lack of transparency regarding what the researchers did (Bryman, 2016). However, as our research aimed to address the multiple viewpoints and interpretations of the participants, and as we throughout strived for transparency in our methodology, so that it is dependable and trustworthy (Oates, 2022).

# 4 Results

*This chapter presents the empirical results from the data collection and follows the structure of our theoretical framework (see Table 2.3). The empirical results are supported by citations from the participants (see Appendices 3, 4, 5, 6, and 7).*

## 4.1 BI-tools Within Swedish Municipalities

When interviewing six employees from Swedish municipalities, various examples of BI-tools were mentioned, see Table 4.1. Some tools are purely used for environmental sustainability purposes, while some have a different purpose but have additional modules or features which address the environmental sustainability aspect. Furthermore, the municipalities were at different stages in the implementation of BI-tools. Jönköping municipality differed from the others, having successfully implemented the entire tool (R1:97). Meanwhile, the remaining municipalities were in the process of implementing the tools.

**Table 4.1:** BI-tools within Municipalities

| Tool | Municipality | Description |
|---|---|---|
| ClimateView | Helsingborg, Lund, Malmö | Facilitates how local governments work with sustainability (ClimateView, n.d.) |
| Carbon Intelligent System | Jönköping | Calculate and analyse climate impact for organisations (Svalna, n.d.) |
| Futureprofeed | Lund | Measure and analyse carbon footprint for organisations or cities (Futureproofed, n.d.) |
| Google environmental analytics | Lund | Free data tool that helps cities measure emissions (Google, n.d.) |
| Miljöbarometern | Helsingborg, Malmö | Climate reporting tool (Miljöbarometern, n.d.) |
| Spend/purchase analysis tool | Jönköping, Lund, Malmö | Relate costs to their climate impact (R1:6; R6:27). |
| Stratsys | Helsingborg, Göteborg, Malmö | A business management system featuring an integrated climate module (R2:17). |

| | | |
|---|---|---|
| Sustainable Advantage | Lund | BI-system that specifies in measuring the Agenda 2030 goals (Sustainable Advantage, n.d.) |

## 4.2 Technology Context

### *4.2.1 Perceived Simplicity*

The responses in terms of the perceived simplicity of the BI-tools were varied. Some respondents believed that the tool was very user-friendly despite challenges in accurately categorising data into the tool (R1:16). Also, R5 from Göteborg municipality expressed that the BI-systems were not perceived as complicated (R5:12). However, respondent R2 from Helsingborg municipality expressed that the BI-tool ClimateView that they were testing was very advanced and difficult to use, mainly because of the interface that was very complicated (R2:35). Also, the system Stratsys, which both Helsingborg and Malmö used, was not found to be easy either (R2:35; R6:19). Respondent R3 underscored that the people working with the tools are not satisfied as it requires some time to make it work (R3:36). R4 also mentioned that the BI-tool ClimateView was very complicated, mainly because it consists of many elements according to the respondent (R4:29). Also, the spend analysis tool was according to respondent R4 more complicated than they thought because of how it was integrated with other systems (R4:29). However, Sustainable Advantage, another system that was used within Lund municipality was perceived as easy to use once you had learned its features (R4:29).

### *4.2.2 Compatibility and Interoperability*

Concerning compatibility and interoperability within the municipality, the responses of its importance for implementation vary. Some respondents mentioned that the BI-tools they are using are not at all integrated with their current systems, making the adoption of the tools easier (R1:14). For example, the tool ClimateView that many of the municipalities use or are currently testing, is not integrated with the municipalities' existing systems (R2:47; R4:31). However, Jönköping municipality aimed to integrate the environmental aspects into their financial BI-system (R1:22). Furthermore, at Helsingborg municipality the tool Stratsys has an environmental module, and the respondent believed that that would be an easy integration to make (R2:47). Similarly, respondent R5 from Göteborg municipality expressed that the tool Stratsys with financial and personnel data could easily connect environmental data into the systems (R5:58).

Meanwhile, R4 mentioned that the municipality's spend analysis tool has not yet been made compatible or synchronised with other systems and not until full synchronisation is achieved, valuable data can be accessed, which posed a challenge for the municipality (R4:22; R4:29). R5 expressed the importance of choosing to integrate the system or not when implementing BI and further that it is more of a strategic question if they should integrate it or not (R5:58). In addition, R6 explained that there were mixed experiences with integrating the BI-tools within different departments, as some departments found the tools to be effective for their processes while others struggled to integrate them (R6:13).

### 4.2.3 Perceived Values

All municipalities expressed that they had expectations for the usage of the BI-tools. For example, R1 at Jönköping municipality mentioned that they expected the implemented tool to facilitate their work and demonstrate the municipality's climate impact, which it did (R1:18). Additionally, the ability to track and visualise the data has resulted in better decision-making and strengthened the municipality's work with environmental sustainability (R1:18). R6 mentioned the aspect of time, emphasising that technology facilitates in gaining comprehensive insights in a short amount of time (R6:19).

Moreover, Helsingborg municipality was not satisfied with their existing systems and mentioned the need for more integrated data-driven approaches as well as streamlining their work with environmental sustainability (R2:8; R3:38).

> *The expectation is that it will streamline our work so that we don't have to look for information within the organisations or outside. It should only come in at the time you want. And that the system itself creates analyses by linking different data. So that we can go forward with nice visualisations and ready-made reports* (R3:38).

Additionally, R3 hoped that the data will create insights about their organisation and provide guidance on which departments need to collaborate on certain issues (R3:40). Similarly, R6 expressed that they needed the tools in order to demonstrate effects and follow-up on their goals in a comprehensive manner, meaning that visualisation is an important aspect with the BI-tools (R6:3; R6:9). R5 further noted that their expectation of the BI-system is to have ownership and control of their data, as well as to be able to facilitate the work within the municipality (R5:14; R5:10). R2 also said that the tool ClimateView or a climate modelling service are more universally applicable, and that every municipality or every county administrative board should have such systems (R2:57). Furthermore, R4 at Lund municipality expressed that the BI-tools would facilitate the work with sustainability, save time for the employees, and obtain a better reliability (R4:24).

However, R4 also mentioned that they were often disappointed with the various tools they implemented, because they probably had slightly unrealistic expectations (R4:105). Similarly, the respondents from Helsingborg municipality expressed negative feelings for certain systems (R2:57).

> *But when it comes to these very municipality-specific issues, you often end up in the clutches of those who develop these systems and tailor them specifically for certain operations* (R2:57).

### 4.2.4 Data Architecture and Infrastructure

A majority of the respondents did not believe that architecture and infrastructure had an influence on the implementation. For example, as the system is not integrated with their current systems (R1:23). Although, the aspect of architecture and infrastructure was emphasised as the most important aspect when implementing and adopting BI-systems for R5 from Göteborg municipality (R5:56).

> *There is a lot of information in Gothenburg municipality that is interesting. To be able to access it in a structured way, there must be an underlying infrastructure that*

> *supports this type of data. Above all, perhaps, the collection of data. It is very important* (R5:18).

However, the infrastructure and architecture within the municipalities are somewhat incomplete. Within Jönköping municipality, the data is in different Excel-files, which is then sent to the system (R1:24). R3 from Helsingborg municipality said that they have mapped the current status of the data architecture and infrastructure in Helsingborg municipality and that they have too many systems, which is problematic and costly (R3:56). Helsingborg municipality is working on creating a "datafactory" where all data can be collected in one place to enhance the analysis and quality of the data (R3:56). Similarly, R5 expressed that they want to own their own data, and additionally that this is not possible with the current BI-systems on the market (R5:8). Therefore, Göteborg municipality is in the process of building a data infrastructure to handle and analyse all of their data (R5:6). Likewise, within Malmö municipality they are working on creating a more comprehensive and integrated management of their data, compared to their current situation (R6:25).

### *4.2.5 Data Quality and Integrity*

Common for all municipalities is the difficulties with obtaining the quality and integrity of the data. A majority of the municipalities had access to a lot of environmental data that could be utilised in the BI-tools. However, this data is dispersed across the municipalities without a comprehensive understanding of its location, and often saved in various Excel-files (R6:13). In addition, R6 explained that there is a challenge with ensuring the accuracy and relevance of the environmental data (R6:11). R2 explained that the climate data is not always up to date, instead it is always between two to three years old and because of this consistent delay, it becomes more challenging to observe the effects of their decisions (R2:45). Also within Malmö municipality they had a similar experience (R6:11). Additionally, while some data at Lund municipality is regulated and clear, this does not apply to the environmental data as it is more internally handled and therefore not clearly regulated (R4:39). R5 further emphasised the importance of quality labelled data.

> *So, we should know that there is a source of information for the data that is somehow quality labelled. Maybe quality assured. So that we know what kind of data we are working with to be able to make the assessment, how essential it will be in an analysis and decision-making context* (R5:18).

Likewise, R6 expressed that they need to work with the structure and transparency of the data, so that they use it correctly in order for the data to create value within the organisation (R6:25). Moreover, there are endless major risks with data that is of low quality and they have procedures when collecting data to avoid this (R5:20). Also, R4 expressed concern that only one person possesses and understands the emissions data (R4:37). Additionally, R4 said they have to ensure the quality of the data in ClimateView, because it is not integrated with their other systems (R4:31). Moreover, R1 expressed that there will always be some errors in the data, for example because of mistakes in different posts in invoices (R1:30).

### 4.2.6 Data Security and Compliance

Most respondents did not believe that data security and compliance had an influence on implementation. Mainly, as the BI-tools involves working with non-sensitive environmental data and not personal data, and as they are not integrated with the other systems within the municipalities (R1:34; R2:59; R4:41; R5:22). Furthermore, respondent R4 mentioned that while data containing personal information may be sensitive, it is important to note that almost all data in the systems are publicly accessible and do not include sensitive information (R4:80).

However, in some cases the municipalities had to take data security into account, for example when it came to integrating the social aspects of sustainability (R1:34). The respondent from Malmö municipality expressed that data security is an obstacle, as some data cannot be shared externally (R6:11).

> *Sometimes we can use research exemptions and similar methods to gain access to more specific data. Then we can use it to understand and work internally, but we can't communicate it externally. [...] It is a bit challenging because you strive to build a system that should be transparent and open and at the same time, it imposes limitations.* (R6:11)

Additionally, some data in the spend analysis tool might be sensitive, because it contains all invoices in the municipality (R4:41). R3 also expressed that they need to work more with the datafactory regarding security factors (R3:60). Additionally, there are some risks with open data and it might result in some authorities not having open data in the future, making the accessibility to data more difficult (R3:120).

### 4.2.7 Available Technology (new)

Common for the municipalities is that, even though they are testing different systems, no single system is currently able to satisfy the scope that the municipalities currently have for the tools (R4:12).

> *You just have to accept that it is not perfect. The data you handle is not perfect either, so you have to be satisfied. You have to find a level that feels reasonable, in terms of satisfaction, and then just go with it* (R4:101).

Similarly, respondent R6 from Malmö municipality expressed that they struggled to find technology solutions suitable for their operations (R6:17). Göteborg municipality has faced challenges in finding the right BI-system for their organisation and has yet to identify a suitable solution (R5:8). From Helsingborg municipality, R2 expressed that the municipality sometimes has procured a system incorrectly, as they have only bought something available and used that (R2:57). Additionally, both R3 and R6 expressed a concern in regards to procuring a system and thereafter being dependent on that particular system's solutions and approaches that are not fitting for the municipality (R3:56; R6:17).

> *It is a bit scary at this point to choose a system and then be stuck with it forever. When we know that there are a lot of smart solutions coming in the future* (R3:135).

Further, R3 expressed that even though they found it to be a risk with choosing a certain system, they also needed to choose one in order to make progress in their sustainability work (R3:56). However, the tools that Helsingborg municipality have tested have not lived up to their expectations in regards to the statistics that can be provided, for example displaying environmental data across an extended amount of time (R2:132).

## 4.3 Organisation Context

### *4.3.1 Cooperation Cross-sector*

All municipalities worked cross-sector regarding sustainability issues. However, issues with the silo-based operations were mentioned. For example, R6 from Malmö municipality expressed this, saying that the silo-based culture within the municipality makes it harder to capture synergies and work efficiently (R6:9; R6:17).

> *This is a challenge for us all the time to find that balance. Instead, everyone finds their own and so we work in the small. That's how it is. So we miss the big picture and can't put it all together. So I would say that the technology aspect is interesting and challenging. (R6:17)*

Otherwise, sustainability is something all departments should work with within Malmö municipality, even though the work is coordinated through the project Klimatomställning Malmö (R6:27). In addition, the different departments individually test different tools, so that they collectively can build their experiences together (R6:29). Jönköping municipality had a joint program for sustainability work that gathers the different departments within the municipality, making the work rather centralised (R1:36; R1:38). Similarly, Göteborg municipality has an environment sustainability programme where the environmental management must cooperate with all organisations in the municipality (R5:24). Within Lund municipality the different departments had main and secondary users that were able to enter and adjust information in the BI-tool ClimateView (R4:43).

For Lund municipality, the team often needs to seek help from other departments that have data relevant to climate issues that they need (R4:43). Also Jönköping municipality cooperated with their technical department when implementing their spend analysis tool (R1:40). Further, the respondent from Jönköping municipality expressed that sustainability issues were not only a departmental issue, but something they need to collaborate on (R1:54). A majority of the respondents expressed the importance of cooperation between different departments within the municipality to be able to work with the complexity of climate change and reach the goals (R3:63; R3:65; R6:11).

> *Something that makes me feel more confident about whether we will succeed in this or not. It's that I now have colleagues in town who take responsibility for ensuring that data comes to us too."* (R3:135).

This is further done through cooperation with private organisations within the municipality (R2:62; R4:49; R6:11) and through climate and energy plans with environmental departments from other municipalities (R3:63). In addition, some municipalities have environmental groups, networks, and forums where they can discuss sustainability issues together with

organisations and departments (R1:36; R5:24). Additionally, the department in which R1 works conducts workshop lectures and inspirational lectures in order to help and support the other departments (R1:36).

However, for Helsingborg municipality, R2 said that there is no network concerning the intersection with data management and sustainability (R2:101). Similarly, R6 expressed that there are networks for sustainability issues, but that the involved cities still work independently, missing a cooperative and holistic stance (R6:21). R1 explained that other municipalities use similar tools as them and that Jönköping municipality has talked to other municipalities about their experiences, as well as pros and cons (R1:64). In addition, through an organisation called Klimatkommunerna, Jönköping municipality has been able to exchange information with other municipalities (R1:66).

### *4.3.2 Top Management Support*

When it comes to top-management support (TMS), the experiences on its influence on implementation are rather uniform in that top-management has not had a significant impact for the actual implementation (R1:46; R4:53). Instead, it has rather been the approval and allocation of funds (R1:46). However, many expressed the importance that top-management had set sustainability development as objectives on the agenda and that this facilitates the work and support for implementing the tools (R2:74; R5:32; R1:38; R6:29). Respondent R6 emphasised that the work must be anchored from the top-management, in order to create alignment for the work (R6:35). Also, R2 explained that digitalisation is a strong driving force for the environmental department in Helsingborg municipality (R2:74).

> *If we had completely disinterested politicians and management, it would have been more challenging* (R4:59).

However, after the politicians have set the agenda, the departments follow up on this and choose how they should do it (R5:32). Similarly, in Jönköping municipality, environmental sustainability issues are handled internally within each department based on the politics (R1:38). Furthermore, within Jönköping municipality the management teams of the different departments have been involved in the work when introduced to the results of the tools and seeing the climate impact each of their departments have (R1:46).

### *4.3.3 Size of Municipality*

All of the participating municipalities are among the bigger ones in Sweden. A majority of the municipalities found that their size had an impact on the implementation of the BI-tools, for better or worse. For example, R1 expressed that their size ensured that they had the funds necessary for the investment of their spend analysis tool (R1:50). Furthermore, R2 expressed that being a big municipality ensured that they had access to enough people working with environmental issues (R2:78). However, R3 emphasised that this makes it more difficult to find correct resources for the project (R3:79).

> *It can be very challenging to find the right person and to understand where the data is and who can help you move forward* (R3:79).

Furthermore, according to R4 within Lund municipality, testing systems is easier for larger organisations where there are more resources available (R4:57). Additionally, in smaller municipalities, individuals may have limited time to dedicate to learning new systems as there

are other tasks that need to be handled within the municipality (R4:57). In contrast to this, R5 expressed that the size of Göteborg municipality was a challenge for working with implementing the tools (R5:28).

> *It is slow-moving. On the other hand, once we decide then, quite a lot happens. We have a lot of technology that enables things in the basement* (R5:30).

Likewise, respondent R6 from Malmö municipality expressed that their size presents challenges and advantages, as the number of employees generates more costs for licences, and that it is harder to obtain a holistic view and understanding of their work (R6:31). However, the size also means receiving more funds, and once the right solutions are found, R6 predicts a more significant impact (R6:31).

### *4.3.4 Organisational Culture*

All municipalities share a commitment for data-driven decision-making (R3:82; R4:61; R5:34; R6:33). Respondent R6 clearly emphasises the culture of being fact-based.

> *It is a professional negligence not to work based on knowledge and data, or to have a good decision-making basis. If we can not demonstrate how we achieve the goals or ambitions set by the politicians, then we're not working properly* (R6:33).

However, there are still some nuances between the respondents. Respondent R1 from Jönköping municipality did not believe that culture had an influence on implementation (R1:52). However, when presenting the results from the spend analysis tool to the organisation, R1 believed that the departments could more easily comprehend the climate impact and understand what their responsibility and challenge within the department was (R1:52; R1:56). And further, that the culture within the organisation facilitated the understanding of the insights provided by the tool (R1:52).

> *There is more discussion between departments on common issues on how we can move forward and reduce emissions. And I believe this tool has definitely supported that.* (R1:54)

In comparison, both Lund and Helsingborg municipality believed that they already had a strong culture where sustainability issues were worked with (R2:62; R4:59). R4 expressed that this led to expectations that they should explore new innovations and technologies that can facilitate the work with sustainability (R4:59). Furthermore, R5 from Göteborg municipality expressed that there were some problems in regards to the pace in which the municipality accomplishes tasks affecting the implementation (R5:42). In addition, respondent R6 explained the presence of organisational barriers within the municipality, as there are different cultures, tools, and approaches in the different departments (R6:27).

### *4.3.5 Balanced and Qualitative Team*

Most respondents mentioned both the use of diverse competencies within the municipality as well as external support regarding the BI implementation. In addition, some of the respondents have even utilised consultants for working with and implementing the BI-tools (R1:6; R2:71). Common among the municipalities is the collaborative efforts, where different

competencies have been attained within the municipality. For example, Jönköping municipality has two environmental strategists working with the BI-tool but is cooperating with other competencies in different departments, both in regards to environmental and economic issues (R1:40; R1:42). Within Helsingborg municipality the environmental work is decentralised so that the environmental strategists are positioned to work with environmental issues with other employees within the municipality (R2:62). Respondent R2 emphasised the need for competencies from different departments within the municipality for the BI-solution to work well (R2:130). Additionally, within Lund municipality the team has representatives with overarching responsibility, and collaborate with people from other departments adding their information to the system (R4:47; R4:49). R6 from Malmö municipality mentioned that there is a lack of expertise today to fully comprehend and utilise all available data (R6:11).

Within the team, R3 emphasised that there has been unity in the importance of finding a BI-solution to obtain better reporting on the environment and climate (R2:72). Additionally, for the team in Lund municipality there is a willingness to experiment with new ideas as they have the expertise and resources for people to take on the responsibilities needed (R4:57). This is also emphasised by R5 who mentioned that each unit must attain or know the ability to make information available and share it with the team (R5:26). Furthermore, the digitisation process poses challenges for employees unfamiliar with the new work processes (R3:129). R1 expressed that there had been some skill development for everyone involved, as well as creating an understanding for how the municipality operates (R1:86). In addition, some respondents emphasised the importance of collaboration and unity within the team (R2:130), R3 said,

> *It is crucial that I have colleagues with me who understand data and digitalisation, and that we all agree on where we want to go. But also, perhaps, that we don't jump at the first thing we see, but have someone who helps me think critically so that I, along with my colleagues and X, can discuss the different choices we have* (R3:129).

### *4.3.6 Change Management*

The municipalities have faced different experiences in regards to the reactions received when working with the implementation of the BI-tool. The respondents from Helsingborg municipality and Lund municipality acknowledged the resistance within their organisations to working with the tools because of the lack of time and energy needed for the work (R3:86; R4:54).

However, there is still a shared belief that the implementation is something that needs to be handled no matter the resistance involved. R5 contextualised change management in the broader challenges of digitalisation, stating that a societal shift is happening towards addressing environmental issues (R5:36). There is within the municipalities an understanding of why the work is important and that there is an agreement that it is an investment that has to be done, as part of the operational planning (R3:86; R2:87). Respondent R6 mentioned the importance of learning, so that the employees collectively shared the engagement and understanding of the process (R6:33). In addition, R6 explained that they must allow for people to experience the transition at their own pace (R6:35).

> *There will always also be those who are comfortable in the current system. [...] And then it is good leadership to recognize that they exist. One should not just override them, but acknowledge them. And one should see it as over time, a shift will be*

> *possible where one has been able to demonstrate enough new benefits or values of the new way of working.* (R6:35)

Likewise, R5 stated that change is always somewhat challenging for people and that handling this is more of a personnel issue than an IT issue (R5:36). R4 found that it is of importance to highlight the advantages to get people on board (R4:67). At Göteborg municipality they manage change with the help of HR, policies, personnel, and guidelines on leadership (R5:38). Within Jönköping municipality, R1 also had to manage employee reactions when presenting insights from the BI-tools as R1 noted resistance and emotional reactions to perceived errors in the data (R1:58). The reactions stem, according to R1, from a lack of both environmental and technical competencies (R1:60).

### *4.3.7 Scope and Alignment IT-business*

All municipalities are united in their scope of implementing BI-tools to facilitate their environmental sustainability work, mainly to assess the organisation's climate impact or to track progress towards climate goals. According to R3, working towards climate neutrality by 2030 has had the highest effect on implementing BI-tools (R3:139).

> *First and foremost, it is the climate crisis, climate neutrality. It is urgent, and many feel that we need to hurry, we need to understand what we are doing well and what we are doing poorly so that we work on the right activities. And in that, we have identified that we do not have the right system solutions today. We have started exploring some, and we need more.* (R3:141).

The goals in regards to sustainability have had a big impact for implementing BI-systems according to R4, and that without the goals, it would be impossible to prioritise the sustainability work (R4:103). In addition, as stricter requirements are set both for corporations and for municipalities to achieve climate goals, there is a need to collect data and gain an understanding of the progress (R3:31).

For this scope a majority of the municipalities utilised or tested more than one type of BI-tools, both tools oriented towards tracking the climate impact of internal procurement, as well as tools to track the progress of municipalities' climate work. For example, Göteborg municipality claimed that they want to simplify the process of analysing comparisons and trends in environmental data with the help of BI-systems (R5:54). In comparison, Jönköping municipality implemented a spend analysis tool to visualise a broad survey for climate work within the municipality (R1:12; R1:12; R1:104). The insights derived from the spend analysis tool could also be used as a basis when communicating the climate strategy externally, as well as for developing action plans (R1:14). Within Helsingborg municipality they wanted to implement a BI-tool for the purpose of tracking their sustainability issues, as well as being able to follow up on the climate goals and Agenda 2030 (R2:32; R2:111; R2:29). Also, R4 and R6 emphasised certain reporting requirements related to sustainable development goals, such as Borgmästaravtalet, where data emissions are reported (R4:83; R6:13).

However, there is a difference in the extent of the scope, as some municipalities were especially concerned with creating long-term strategies and processes for working with sustainability holistically across the municipality and wanted the tools to correspond to this scope (R6:11; R6:13; R2:87; R3:88; R5:10). In addition, there is a struggle with integrating the operational management within the municipality with the environmental work and data

that the municipality has (R6:23). In addition, the organisation must have the prerequisites and technologies aligned with its culture and processes to succeed with implementation (R6:35).

> *And one must see this step of creating understanding as the first thing we have to work on. Thus, we must continue to explore, but also look at expertise. Do we have resources, do we have prerequisites, technologies for instance? Do we have a culture that enables this new way of working?* (R6:35)

### *4.3.8 Available Time (new)*

Some respondents mentioned the challenges with having available time and resources allocated for the work with the tool. Employees within the municipality are pressed in regards to both budget and time, which leads to them not being enthusiastic with technology implementation and this affects the results of the implementation (R4:65).

> *It still costs in time. For us who have to work with it, it also has to be worth that time. It is time that you cannot spend on something else. That needs to be justified"* (R4:67).

Likewise, R6 emphasised time as a valuable resource, as there is a need to allocate it efficiently and correctly (R6:39). Also within Helsingborg municipality there is an aspect that the new systems create new work processes, requiring more time from the employees (R3:91). Similarly, according to R4, there was an issue with people within the municipality not being enthusiastic about the project as they are pressured in terms of budget and time, and not because they do not see the advantages with the systems (R4:54). Furthermore, this aspect might be more profound in smaller municipalities that have even less resources to allocate for trying new innovations for environmental sustainability (R4:57).

## 4.4 Environment Context

### *4.4.1 Funding (normative)*

A majority of the respondents felt that funding was an aspect when implementing the BI-tools. Still, some respondents mentioned that the BI-systems they were working with were not very expensive compared to other information systems within the public sector (R1:46; R4:67). Even so, many of the respondents explained that they did not have enough money allocated for making these kinds of investments. R5 highlighted that the sparse funds necessitated smarter work and increased collaboration within the municipality (R5:42). R2 and R6 similarly mentioned that if the municipality would have enough allocated money, they could have solved the implementation directly by purchasing a system and getting additional help from consultants (R2:87; R6:17).

> *The other operational system for environment and food, it costs 850,000 per year. That's a lot of money. If we had received 850,000, we could have had really smart systems* (R2:87).

Furthermore, three respondents explained that they had utilised leftover funds from ongoing projects to implement or test the BI-tools (R1:46; R1:68; R4:53). Additionally, Helsingborg municipality also mentioned that existing systems or modules that were free of cost had

driven the municipality to test it (R2:30). The municipalities expressed that if it were not for leftover funds or the use of free systems, they would not have tried it in the first place (R4:73). Similarly, for Malmö municipality external financing has been very important for the initial work but that they need even more financial resources for the projects (R6:39).

For the municipalities there is a challenge of allocating resources within the budget, in part because there is a political need for improving efficiency through the investments (R2:90). Also R5 mentioned that there was a political consideration of how much the systems are allowed to cost (R5:42). Further, respondents R4 and R6 mentioned the apprehensiveness in investing in information systems and that they had to choose carefully (R4:73; R6:17). R4 said,

> *So, you can try out a system like this and see if it was worth it or interesting because then it doesn't take the money from the municipality's regular budget but rather is allocated to a project. Implementing new systems, of course, costs a lot of money for the municipality* (R4:53).

### 4.4.2 Political Powers (normative)

Not many respondents believed that political powers had a direct influence on the implementation of the BI-systems (R1:72; R5:44). Still, many respondents gave examples of the role of politics in regards to this subject. Some respondents highlighted that despite the differing views on specific issues within politics, there was still a shared recognition of addressing environmental challenges, no matter the party affiliation (R2:103; R4:75; R5:44). R2 said,

> *For many years now, we have had a blue conservative government, and it is still the case that we want to pursue climate neutrality by 2030. In general, it is part of our DNA to drive sustainability issues* (R2:103).

In contrast, R6 expressed that changes in their operations will occur when there is a change of political office, adding a difficult aspect when working with implementing BI-tools for sustainability (R6:29). Also, R1 reflected that for some politicians, the money matters, and that there is a general mindset that the city needs to build more (R1:56). Some respondents mentioned the importance of politics concerning these questions. R2 found that Helsingborg municipality has a strong city director culture, where environmental initiatives are influenced by the director who has authority both over the departments and the municipal companies (R2:62). Respondent R4 further emphasised that the political prioritisation of environmental issues is reflected in government documents and support the work they are doing,

> *It is basically essential that it is stated in the municipal policy documents that one should work on it. If it is not stated there, it is more difficult* (R4:103).

Likewise, R6 highlighted that the politics serve as a foundation for the operations and shape the projects, finances, and overall governance (R6:29). R5 further elaborates that they have two ways to govern, where one is the municipal council's budget, and the other is the governance model for digitalization (R5:44).

### 4.4.3 Citizen Participation (normative)

A majority of the municipalities agree that citizen participation had minimal to no influence on the implementation process (R1:76; R2:105; R4:79; R5:45). However, R6 explained that the municipality as an organisation is dependent on local actors and citizens to make sustainable decisions and investments (R6:41). Both R6 and R5 highlighted the challenges of citizen involvement as there would probably be limited engagement among the public, something the municipality cannot enforce, and that this fragmented data set would not be rewarding to take into account (R4:79; R6:41).

> *It is difficult with citizen involvement in such data. Often, you only get a few involved, and if you do not get everyone involved, I am not sure if it is worth it"* (R4:79).

Despite the lack of influence from citizens on implementation some expressed that it probably would be of interest for the citizens to then see the statistics made from the implementation, especially as the data that could be presented was very concrete (R1:74). Also respondent R5 from Göteborg municipality had developed web pages to communicate with citizens on how the city is working with environment and climate change issues (R5:45).

### 4.4.4 Regulatory Frameworks (normative)

Regulatory frameworks had an influence on the implementation within the municipalities, even though some expressed that this influence was not significant (R1:78). For example, as Jönköping municipality needed to produce data processing agreements (PUB), the process of implementation was delayed (R1:78). Within Göteborg municipality, R5 believed that regulations and laws had a quite large effect on their adoption of BI, hindering the implementation (R5:48).

> *This is a major obstacle to digitalisation in general and it is a major obstacle to this because it is also the case that there is some information that is certainly classified and there is even environmental information that falls under the Security Protection Act* (R5:48).

Similarly, R6 from Malmö municipality found that rules and regulations could be a hindrance when implementing and working with sustainability issues (R6:7). Further, R6 expressed that there is a challenge in regards to the responsibility of the municipality, as they do not always have sole authority over certain decisions, making it more difficult to handle sustainability issues (R6:5). Additionally, there is an uncertainty concerning ownership and management of procuring new systems within the municipality (R6:17).

In addition, corporate sustainability reporting (CSR) has both driven and facilitated the work towards a BI implementation within Helsingborg municipality, in part as the regulation sets requirements for data collection that the municipality can take advantage of (R3:108; R2:109). Respondent R3 expressed that these kinds of regulations make R3 more interested in BI solutions and makes them realise that they need to start utilising them (R3:108). Additionally, the government within Sweden also has certain requirements for data collection and reporting to public institutions such as Naturvårdsverket and Havsmyndigheten (R2:109). R2 also said that they are reporting to a Carbon Disclosure Project and that BI-tools could facilitate this work (R2:109).

### 4.4.5 Quality of National Information Infrastructure (normative)

The quality of national information infrastructure has not had an effect on the implementation according to a majority of the respondents (R1:84; R4:87; R2:119; R5:50). In addition, one respondent from Helsingborg municipality added that governmental open data is getting better, and that its accessibility is important for implementing BI-tools (R2:119). Respondent R5 reflected that some places in Sweden might have problems with the quality of national information infrastructure (R5:50).

### 4.4.6 Mimetic Pressure

A majority of the municipalities expressed that, in contrast to being influenced by other municipalities, they themselves inspired others through telling other municipalities of their data-driven journey (R1:64; R4:69; R6:37). Still, respondents also mentioned collaborative efforts between different municipalities. For example, R2 explained that in regards to ClimateView, other municipalities have been important when Helsingborg municipality has worked with the development of the tool,

> *It is large, skilled environmental municipalities. So it is Lund, Malmö, Umeå, and Stockholm that have also contributed to its development to what it is* (R2:99).

Also respondent R5 from Göteborg municipality collaborates with other municipalities and administrations, where their management teams meet with management from other municipalities (R5:40). Further, the respondent from Lund municipality (R4) mentioned that Helsingborg municipality as well as Upphandlingsmyndigheten had an influence when Lund municipality decided to implement a purchase analysis system (R4:20). Some respondents also mentioned the advantages when other municipalities test systems before they themselves do, as they then can have discussions revolving around the system (R4:69). Malmö municipality has taken inspiration from both international cities, such as New York, and private organisations when it comes to identifying strategies for governing and systematising their environmental work (R6:37).

### 4.4.7 Governmental Support (new)

Some municipalities mention the initiatives and support coming from public institutions. For example, Lund municipality uses emissions factors provided by Upphandlingsmyndigheten (R4:22) and Helsingborg municipality has a project funded by Energimyndigheten, from which they receive resources (R2:99).

A few respondents have expressed that the work with implementing these tools for sustainability has been difficult and that they have lacked support in the matter. For example, Lund municipality was quite early in adopting BI-technology and R4 indicated that this meant that they were a bit lost in the whole process (R4:69). Respondet R6 emphasised that the work with technologies for sustainability could be coordinated nation-wide to transform on a broader scale (R6:21).

## 4.5 Individual Context

### *4.5.1 Social Influence*

Among the respondents, it has been expressed that proactive individual involvement in implementing the BI-tools have affected the implementation (R1:68). One respondent expressed the importance of the employees having curiosity when working with digitalisation (R5:52). Within Lund municipality, one person was responsible for managing the data, identifying where the information was stored, its format and how to access it (R4:55). The importance of social influence was highlighted by R6, who expressed that individuals that had experience and knowledge of the organisation wielded informal power (R6:33). This connects to the fact that contrary to top-down leadership approaches, the implementation of BI-tools was often driven from the middle-up (R1:48; R2:76; R4:55; R6:48).

> *It is on the operational level where we can get the drive and perhaps bring about change and create understanding among ourselves. So it is both top-down processes, but also a bit guerrilla work, if you want to call it that. There is courage there, and there is drive among individuals. Which is greater than the organisation.* (R6:48)

### *4.5.2 Hedonistic Drive*

Most respondents acknowledged that the usage of the BI-tools was pleasurable and fun as it could enhance understanding and make complex data more engaging. For example, R1 expressed the user-friendliness of the BI-tool.

> *It is a user-friendly tool. It presents simple numbers and colours with some bar graphs and circles on quite a complex lifecycle management of emissions, from cradle to grave*. (R1:90).

One respondent discussed the importance of presenting emission statistics in an attractive and understandable manner, which made sure that people would engage with it more effectively (R4:90). One respondent expressed that there is a curiosity that has driven the implementation process forward (R5:52). Additionally, R2 and R6 found that there was a social aspect to what made the tool fun to work with, as it brought the team together (R2:130; R6:43). However, frustration was also aimed towards the tools. Especially, when the tool did not reach the expectations of the team and therefore leads to a lack of motivation for the process (R2:132).

## 4.6 Task Context

### *4.6.1 Task complexity*

All respondents underscored the complex nature of working with climate issues within the municipalities. For instance, R1 expressed that there is a complexity in understanding the climate impact of purchases, considering both upstream and downstream factors (R1:90). In addition, R6 highlighted the difficulties with handling the climate challenge within Malmö municipality with its local differences.

> *Malmö is not a homogeneous city where it looks the same in all neighbourhoods. We must understand each neighbourhood. So it's this kind of big common challenge. How do we build local knowledge, if you will, to be able to make decisions that are adapted to specific contexts?* (R6:11)

As well as difficulties with the political perspective when working with sustainability, in addressing disparities in quality of life and emissions between different areas within the municipality (R6:41). This complexity also extends to bridging the gap between the municipality's operations and the reality of their climate impact, as noted by R1 (R1:91). Furthermore, some participants also mentioned the intricacy of working with sustainability in its different aspects, and that the work they are doing is just a smaller part of a larger sustainability effort (R1:95).

Furthermore, all respondents expressed hope that BI-tools could automate and simplify data collection. Additionally, R1 reflected on the climate impact made by the municipality and said the BI-tool has facilitated for finding and understanding the indirect emissions within Jönköping municipality, therefore that the tool has simplified something that is extremely complex (R1:93; R1:90). However, R1 mentioned that there are limitations to the scope of tracking goals related to climate impact, and that there is no organisation that is able to include all of their climate impact in their climate reporting (R1:104).

### *4.6.2 Task interdependence*

Participants highlighted the interdependence surrounding the assessment of climate impact associated with municipal activities, such as with procurement activities. For example, the respondent from Jönköping municipality mentioned the inclusion of various aspects related to operating a consulting business that had been taken into account to calculate the climate impact (R1:91). Likewise, R6 expressed the difficulties when measuring specifically environmental data and what indicators to use (R6:23).

One respondent from Helsingborg mentioned that they lack access to relevant open data to address social and economic aspects of sustainability across different regions, in addition to environmental data (R2:111). Additionally, some respondents expressed that the tool might not account for the broader context of efforts to reduce environmental impact, such as when the municipality sets higher standards for environmental procurement (R1:106). Making it hard to utilise the BI and spend analysis tool as a KPI for the environmental work (R1:106).

Additionally, the majority of the respondents explained that the fragmented nature of data across the municipalities further complicates the work with sustainable development. Within Malmö municipality there is a challenge of aggregating the sources of information, and understanding where the responsibility lies for the data (R6:11). Likewise, R2 said,

> *There is data from other departments that is also relevant for environmental and climate monitoring, which we may not always have access to because we're not aware of the existence of various Excel files with relevant information* (R2:29)

This fragmentation leads for example to delays in reporting on climate impacts due to the time-consuming process of gathering necessary data (R2:32). For example, R3 expressed that

they themselves will have to handle the many reports manually if they do not have a system in place and expressed great reluctance towards this (R3:139).

# 5 Discussion

*In this chapter the findings from the study are discussed with the help of the literature and the theory Integrated T-O-E. The chapter is structured in accordance with the concepts from Integrated T-O-E (see Table 2.3).*

This study investigates the adoption of BI-tools within municipalities for environmental sustainability to explore the perceived importance of critical success factors for implementation. As earlier research has addressed the implementation of BI-tools in organisations, as well as technology implementation in municipalities respectively, there is a lack of a comprehensive and in-depth study that examines the intersection of BI, environmental sustainability and municipalities combined. Following this, the findings show that participating municipalities are currently working with implementing different BI-tools for environmental sustainability initiatives. The actual usage of the BI-tools within the municipalities corresponds to the literature, describing BI as the gathering, storing, accessing, and visualising of data with applications (Sharda et al. 2018; Wixom & Watson, 2010). Furthermore, the findings reveal that the usage of BA involves the descriptive use to gain a comprehensive overview based on their historical, environmental data (Appelbaum et al. 2017; Sharma et al. 2022). The literature concerning BI often highlights the decision-making aspect as the main purpose of the tool (Chatterjee et al. 2024; Wixom & Watson, 2010; Zaamer et al. 2022). However, the findings as well as the literature on BI for sustainability rather highlights BI's ability to improve gathering of environmental data, identify environmental issues and areas of development, and increase visibility of sustainability metrics, with the purpose to reflect on sustainability performance (Cheng et al. 2023; Muntean, 2018; Petrini & Pozzebon, 2009; Shi et al. 2023). Moreover, most of the municipalities are in the earlier stages of this implementation, as was indicated in the literature (Digg, 2022b; Ripgården, 2021), and have not yet finalised their implementation or even decided on what system to use for their long-term operations. The findings further indicate that there is consensus in the challenges and experiences that the municipalities had when working with the implementation of the tools, however nuances in their experiences could be found as well.

## 5.1 Technology Context

*The following section investigates the CSFs for the technology aspect.*

The findings showed that the CSF *perceived simplicity* is perceived to have an influence on the adoption of BI-systems. According to Awa et al. (2017), when the system is perceived as easy to use, its implementation will be more successful. The findings indicate that some BI-systems were perceived as easy to use while others struggled with the complexity of the systems. According to Awa et al. (2017), the perceived complexity of the systems could be a reason that many of the municipalities faced challenges when implementing the tools. The perceived complexity of the tools could be explained by the literature saying that there is an inconsistent digital maturity and non-digital mindset among the employees (Joukhadar et al. 2023). Additionally, while user skill sets are a primary consideration for BI initiatives (Sharda et al. 2018) might this affect the implementation negatively.

Furthermore, it is important that the BI-system is compatible with the organisation's current systems for a successful implementation (Awa et al. 2017; Jonathan, 2020). The findings about the CSF *compatibility and interoperability* are varied. Mainly, the findings revealed that based on the type of BI-system being implemented, this influenced adoption. While most systems were not integrated with the municipalities' current systems, compatibility was not an issue. When the BI-system had to be integrated, then its implementation was hindered because of compatibility issues, as supported by Awa et al. (2017).

Regarding the CSF *perceived values* the findings revealed that all municipalities expected the BI-tools to provide significant value. According to the findings, the municipalities valued the BI-system for its potential to facilitate their climate-related efforts. In addition, the findings also exhibit that even though there had been a high perceived value of the tools, this led to disappointments in its implementation, motivated because of the unrealistic expectations and challenges with customisation for specific municipal needs. This does not align with Awa et al. (2017) who emphasise the higher perceived value the more likely the implementation will succeed. Still, the findings show that some municipalities had expectations that the BI-systems would facilitate their climate work which it did.

Regarding the CSF *data architecture and infrastructure,* having a strong data infrastructure is important for successfully analysing the data and ensuring its quality (Goede, 2021; Jonathan, 2020; Sharda et al. 2018; Yeoh & Popovič, 2016). The findings show that most of the employees did not find that this had an influence on implementation. Mainly, as the BI-systems were not integrated with the architecture. In addition, the public sector has unique requirements for transparency and regulatory compliance (Chen, 2017; Pang et al. 2014). The findings indicate that municipalities for this reason work with data architecture to meet these demands, ensuring they have a reliable and integrated data infrastructure to support governance operations.

The findings showed that all municipalities had difficulties with the CSF *data quality and integrity*, a factor mentioned as important in the literature (Jonathan, 2020; Yeoh & Popovič, 2016; Ziemba, 2021). Most of the municipalities reported difficulties in working with environmental data due to its frequent lack of up-to-date information and challenges related to data accuracy. This affected their ability to observe the effect of their environmental impact, which is in line with (Yeoh and Popovič, 2016; Ziemba, 2021) where the authors claim the quality of data must be reliable and useful to make effective and better decisions. The delay in data, often due to lack of real-time updates, hinders the municipalities' ability to assess current environmental conditions accurately and plan appropriate interventions. Furthermore, Yeoh and Popovič (2016) highlight the importance of maintaining data across the organisation. The findings indicate that this is challenging for municipalities due to the various departments with their distinct data and systems. As indicated in literature on municipalities' silo-based data management (Digg, 2022a; Joukhadar et al. 2023). This may be one reason why municipalities struggle with the CSF and feel its effect on implementation.

Regarding the CSF *data security and compliance* (Jonathan, 2020). The findings indicate that this was not an important factor for implementation. As indicated in the findings, one reason for this could be that environmental data does not contain sensitive information. If the municipalities were working with other types of data, this CSF might have been more prevalent in the findings. This is supported by the fact that when data security had to be considered, this proved as a hindrance in the implementation, according to the findings.

Finally, the literature is unified in the benefits for municipalities of utilising data for their operations (IBM, 2020; Allam & Dhunny, 2019; Joukhadar et al. 2023; Digg, 2022). However, the findings indicate that many of the municipalities highly struggled with finding a concrete BI-solution for the work that they were currently conducting. Therefore, a new CSF was stated, namely *available technology*, describing the importance of the actual existence of technology that is compatible so that it can be aligned with the strategies and operations of the municipalities' environmental sustainability work and satisfies their needs. Within the IS field, the importance of IS and business alignment is highly emphasised (Sharda et al. 2018; Yeoh & Popovič, 2016). Therefore, the findings that indicate an apprehensiveness for municipalities to invest in a technology deemed as non-fitting for their operations can more clearly be understood. An apprehensiveness that is also supported by literature (Joukhadar et al. 2023; Carlsson et al. 2023). However, in contrast Goede (2021) argues that strongly aligning information systems with business objectives might not be imperative because it primarily reflects the narrow perspectives of a small group of users, decreasing the diversity of the system and its use. Likewise, a respondent in the findings expressed that instead of waiting for the perfect solution to present itself, they might need to just choose one.

In summary, while some CSFs like *perceived value*, *compatibility*, *data security*, and *data architecture and infrastructure* had varied perceived impacts on implementation due to differences in system integration, others such as *perceived simplicity*, *data quality*, and *available technology* were generally seen as important. Despite literature emphasising the benefits of utilising data for municipal operations, many municipalities struggled to find suitable BI solutions, highlighting the need for technology that fits their specific needs.

## 5.2 Organisation Context

*The following section delves into the CSFs in the organisational context.*

The findings showed that the CSF *cooperation cross-sector* (Krantz & Gustafsson, 2021; OECD, 2019) was important for sustainability. Most of the municipalities expressed that the departments must cooperate with each other when it comes to climate change. In addition, the findings indicate that the departments utilised different competencies across the organisation, which is emphasised by Yeoh & Popovič (2016), as a successful implementation consists of a competent staff with technical and business skills. Still, the findings indicate that there are persistent challenges for cooperating such as the silo-based culture affecting their work on both sustainability and BI. This aligns with Joukhadar et al. (2023) who emphasises the silo-based approach leads to slow technology adoption. Furthermore, it aligns with Digg (2022a) that explains the different departments in each municipality have different IT-systems, which makes it challenging to cooperate with each other. Both to address the sustainability work, as well as to aggregate the data needed for the work.

Moreover, the CSF *top management support (TMS)*, often highlighted as one of the more important aspects for implementation (Awa et al. 2017; Goede, 2021; Jonathan, 2020; Raut et al. 2019; Sharda et al. 2018; Yeoh & Popovič, 2016; Ziemba, 2021) had no significant impact on implementation, as perceived in the findings. A potential reason is that all municipalities are at the first target, namely "few applications" of BI in organisations according to Wixom and Watson (2010). At this level the commitment is often low or medium and only affects the business unit (Wixom & Watson, 2010), which is in line with how the municipalities facilitate

BI in their organisation. Still, even though the findings show the employees' perceived insignificance for the factor, the findings also show that the top management de facto set the objective for their work and that it was perceived that without this support, the adoption would be difficult. Which is in line with the literature (Awa et al. 2017; Goede, 2021; Jonathan, 2020; Raut et al. 2019; Sharda et al. 2018; Yeoh & Popovič, 2016; Ziemba, 2021).

Furthermore, the findings showed that the CSF, *size of municipality,* (Awa et al. 2017) had both positive and negative impacts on the implementation. The positive impacts included having more funds and sufficient staff. However, the findings highlight negative impacts, that the large size made it difficult to find the right people and data, as well as slow mobilisation and making it hard to obtain a holistic view over the entire organisation. This aligns with Joukhadar et al. (2023), who emphasises that municipalities experience slow mobilisation in technology adoption and operate with silo-based services, making it difficult to obtain a holistic view. Moreover, as the findings indicate that the size affects the implementation, both negatively and positively, this is in line with Awa et al (2017).

The CSF *organisational culture* emphasises the importance of the culture within the organisation, for example having a data-driven culture (Jonathan, 2020; Sharda et al. 2018; Zaamer et al. 2022; Ziemba et al. 2021). The findings show that all municipalities had a commitment for data-driven culture. Which somewhat contrasts with the literature saying that municipalities have a non-digital mindset (Joukhadar et al. 2023), as well as highlighting the need for more digital experimentation and digital innovation within the public sector (OECD, 2019). In addition, the findings also showed examples of a culture with commitment to sustainability, which helped drive the efforts of implementing technology for this purpose. However, the silo-based units within the organisations have led to varying cultures and approaches across different departments, making BI implementation challenging at times. This observation aligns with literature on municipal silos as an obstacle for change (Joukhadar, et al. 2023; Digg, 2022). Moreover, the findings reveal that while the culture affects the implementation in various ways, it still has an influence, as indicated by the literature (Jonathan, 2020; Sharda et al. 2018; Zaamer et al. 2022; Ziemba et al. 2021).

Furthermore, in regard to the CSF *balanced, qualitative team and experts* mentioned as important in the literature (Goede, 2021; Yeoh & Popovič, 2016; Zhang et al. 2022). The findings show that municipalities use internal and external competencies when implementing BI-systems, which aligns with that the BI-team must be balanced in order to successfully implement BI (Goede, 2021; Yeoh & Popovič, 2016). Furthermore, the municipalities are also reflecting over and enhancing their competencies. This aligns with the literature, highlighting the importance of developing competencies (Jonathan, 2020; Pang et al. 2014; Ziemba, 2021). The findings from some municipalities indicate the necessity of diverse competencies and collaboration for successful BI implementation, aligning with Yeoh and Popovič (2016) emphasis on the importance of teams with both business and technical skills. Still, the findings exhibit that there is a lack of expertise to fully utilise data and an unfamiliarity to the new work-processes hindering the implementation, which is supported by Gillon et al. (2014). Furthermore, Zhang et al. (2022) emphasised that cooperation between BI and sustainability experts (consultants) is necessary for BI adoption in sustainability. However, findings show that only two municipalities utilised consultants when implementing the BI-systems. Incorporating BI and sustainability experts could therefore help the municipalities address the expertise gap and enhance data utilisation.

Moreover, the CSF *change management* is also highlighted in the literature (Goede; 2021; Jonathan, 2020; Yeoh & Popovič, 2016; Ziemba, 2021). Likewise, the findings indicate that

this CSF is perceived to influence the implementation. Specifically, as the municipalities experience resistance within the organisation because of a lack of time and energy, affecting the implementation. Which is supported with literature on municipalities (Joukhadar et al. 2023; SKL, 2019). In addition, the findings demonstrate that there is an understanding that the transition towards working with BI for sustainability requires collective learning and allowance for individual pacing. Effective leadership was seen as crucial in acknowledging resistance and highlighting the benefits of the new system, with strategies such as HR involvement, policies, and guidelines to manage change. The literature similarly highlights these aspects concerning the organisational context for implementation (Jonathan, 2020; Krantz & Gustafsson, 2021; Ziemba, 2021).

Regarding the CSF *scope and alignment IT-Business,* the findings indicate that all municipalities have a unified scope to facilitate their environmental sustainability across the organisation. Primarily, to assess climate impact and track progress towards climate goals. The urgency in addressing the climate crisis, and following the goals addressed in Agenda 2030 is a driving force behind the implementation. As well as keeping up with stricter requirements set in regulations. All of which corresponds to what the literature says about environmental work for municipalities (Krantz & Gustafsson, 2021; SKR, 2024; PWC, 2023). Furthermore, literature clearly shows that technology (Watson et al. 2010; Melville, 2010), and specifically BI can be used for this scope (Cheng et al. 2023; Muntean, 2018; Shi et al. 2023). However, differences existed in the scope and therefore choice of BI-tool, as some focus on long-term strategies and holistic sustainability approaches, while others have a narrower scope to addressing sustainability. The aspect of green IS, as described in the literature (Chen & Roberts, 2023; Loeser et al. 2017), connects to the long-term orientation of the tools for sustainability. Also, public value is an aspect (SKR, 2023b; Twizeyimana & Andersson, 2019) that can be connected to creating long-term solutions, as the municipalities face a responsibility in handling these issues over time for the common good of the citizens.

As highly emphasised in literature, there is an importance of ensuring that the BI-tools supports and aligns with the business strategy (sustainability in this context) (Sharda et al. 2018; Yeoh & Popovič, 2016). Its importance can be felt in the findings as there are challenges in integrating operational management with environmental work and aligning technology with the organisational culture and processes. Indicating the need to create an understanding and assessing resources and prerequisites for implementation. Interestingly, even though the municipalities are currently at the "few applications" target as described by Wixom and Watson (2019), where the scope is limited to specific business units, the long-term strategy municipalities are also demonstrating an organisation-wide scope that aligns with the "organisational transformation" level identified by Wixom and Watson (2019). This causes a misalignment in the resource allocation in BI-system and environmental strategy.

Finally, regarding the organisational context, the findings exhibit the contextual challenge of working with digital innovation and sustainability within the municipality. Namely that the employees, having their ordinary tasks, must allocate time for this work that they nonetheless find important. Therefore, the CSF *available time* was found to be an aspect influencing the implementation of BI-tools for environmental sustainability initiatives. The literature shows that Swedish municipalities face challenges with balancing routine operation with operations for digitalisation and innovation (SKL, 2019). Likewise, the findings indicate that the municipal employees face constraints in both budget and time, leading to a lack of enthusiasm for technology implementation even though there is a perceived value for the implementation

per se. In addition, this challenge might be even more pronounced in smaller municipalities with even fewer resources. This situation presents a Catch-22 scenario, while on one hand the tools are seen as valuable for enhancing the efficiency of environmental sustainability efforts, as underscored by literature (Pang et al. 2014; Chen, 2017; SKL, 2019). On the other hand, implementing these tools requires that the municipal employees allocate resources, including time, which they already need.

In conclusion, the organisational context emerges as paramount in the perspective of the municipal employees. Only the CSF *top management support* appears to have less perceived influence on implementation, despite its importance highlighted in the literature.

## 5.3 Environment Context

*The following section delves into the CSFs for the environmental context.*

The findings indicate that the CSF *funding* is an important aspect for municipalities. As emphasised in the literature, funding is a key factor when implementing technological tools within government (Ziemba, 2021; Jonathan, 2020; Awa et al. 2017). However, the municipalities face challenges in allocating resources for implementing the BI-tools for environmental sustainability, and most of the initiatives for implementation are based on leftover project funds. As explained by Carlsson et al. (2023) and SKL (2019), municipalities allocate less funding than the private sector and struggles with balancing routine operations with allocation of resources for digitalisation and innovation. The findings indicate further that the limited funding necessitates smarter work and increased collaboration within municipalities. Still, parts of the findings exhibit that the BI-tools are not as expensive as information systems often can be within the municipality, which can be supported in the literature, whereas the implementation can be seen as the first target level, requiring low to medium resources (Wixom & Watson, 2010). Another aspect to funding in the context of municipalities is the fact that municipalities receive the fundings based on taxpayers, meaning that there is an expectation from the public that these are allocated correctly (SKR, 2023b; Twizeyimana & Andersson, 2019).

Furthermore, the CSF *political powers* are another factor that has been emphasised in the literature, both for sustainability initiatives, as well as for technology implementation (Jonathan, 2020; Caudle et al. 1991; Krantz & Gustafsson, 2021; Awa et al. 2017). In contrast, the findings exhibit a contradictoriness as the political influence is claimed as non-important for the implementation. However, at the same time the findings indicate the importance of the political agenda, where the efforts for both digitalisation and sustainability are prioritised. Especially regarding the sustainability issue, the findings indicate that even though the political party changes, sustainability is continuously on the agenda and supports digitalisation for this purpose. Therefore, the question of political support might be something of a non-question, as its support is taken for granted.

In regard to the CSF *citizen participation*, the findings clearly show that this has not had any influence on adoption of the BI-tools within municipalities. As contrasted with the literature (Jonathan, 2020; Awa et al. 2017). The reason might be that the tools do not affect the citizens per se, so that their involvement does not become necessary. As the BI-tools are used for environmental sustainability initiatives where the municipalities track their work and try to lower their emissions internally, this does not affect the citizens more than that the initiatives

indirectly creates public value for the citizens in terms of a more sustainable community. In addition, the involvement of citizens in the BI-tools are further emphasised as difficult in the findings, as not all participants might be committed to admitting their environmental data, lowering its value. Which is an advantage that has been mentioned in the literature, while BI&A can assist the municipalities in understanding the behaviours and needs of the citizens (Digg, 2022a; Pang et al. 2014; Allam & Dhunny, 2019). In addition, literature also highlights how leveraging BI&A can empower citizens and improve transparency (Chen et al. 2012). Aspects that seem to be missed in the current implementation for environmental sustainability, according to the findings.

When it comes to the CSF *regulatory frameworks* that literature highlights as important for implementation (Jonathan, 2020; Awa et al. 2017), the findings differ. There is evidence that these both influence the implementation process, mainly as an obstacle for implementing the tools effectively, and that they do not have an influence on implementation. Examples for being an obstacle include delays because of PUB and having to comply with security protection acts. In addition, the findings highlight the experience of one respondent expressing that there is an uncertainty as to where the responsibility for sustainability and digitalisation processes lie within the organisation, making the processes difficult to handle. However, regulatory frameworks could also facilitate the process, as for example CSR and the Annual Accounts Act regulating private organisation, also prompts governments to keep up with the new directives (PWC, 2023; SFS 1995:1554; European Commission, n.d). Likewise, Swedish government requirements for data collection and reporting to public institutions further underscore the importance of BI-tools in meeting regulatory obligations, which both the findings and the literature indicate (Yasmeen et al. 2020; Zhang et al. 2022; PWC, 2023).

The CSF *quality of national information infrastructure* is shown as having no significant influence on implementation within municipalities, according to the findings. As contrasts with the literature, emphasising the importance of sound national infrastructure to be able to implement technology tools (Jonathan, 2020). The reason for the contradictory findings could be the same as for the CSF *political powers*, that the national infrastructure is taken for granted as something solid within the big municipalities. If instead the study had been conducted in a smaller city, the findings might differ.

Moreover, in regard to the CSF *mimetic pressure*, literature states that this amounts to organisations observing other organisations and mimicking their actions to remain competitive (Awa et al. 2017). However, as municipalities do not have the imperative to “stay competitive”, but rather generate public value (Twizeyimana & Andersson, 2019), the importance of this CSF can be questioned. In addition, the findings also indicate that the municipalities do not really feel themselves influenced by other municipalities to adopt and implement BI-systems, even though collaboration between the municipalities to some extent is occurring. This could further be connected to the fact that municipalities are rather silo-based and that initiatives are made within each municipality as expressed by literature (Joukhadar et al. 2023; Digg, 2022) and the findings, resulting in that they themselves must solve the sustainability issue and handle the digitisation process on their own. Even though all municipalities are currently undertaking these challenges, the findings exhibit that they themselves feel that they are among the first laying ground to this work.

Finally, concerning the environmental aspect, a new CSF could be detected, namely *governmental support.* This factor is similar to *political powers*, as well as t*op management support*, however as political powers involves the influence that the local political party has

on the municipality (Jonathan, 2020) and the TMS involve the influence that the management with its managers within the municipal departments have (Jonathan, 2020), the governmental influence involves the support that comes from the Swedish parliament and its governmental institutions. The findings somewhat indicate that there has been a lack of support in the matter and that coordination of the subject should rather occur on a nation-wide scale so that the efforts are facilitated.

Regarding the environmental context, perceived from the municipal employees, few CSF were perceived as very important when implementing the BI-solutions. Firstly, even though BI-tools for environmental sustainability are affordable, the impact of *funding* could still be felt within the municipality. Furthermore, *political support* seems to be crucial, but its direct influence was debated. The same could be said about the CSF *quality of national information infrastructure*. *Citizen participation* is minimal as BI-tools mainly impact the internal operations of the municipalities. Likewise, *mimetic pressure* does not seem to influence the implementation of the municipalities. *Regulatory frameworks* presents mixed opinions on its influence on implementation. Finally, *governmental support* is identified as a new critical success factor, indicating a need for nationwide coordination.

## 5.4 Individual Context

*The following section considers the CSFs for the individual context.*

The aspects of social influence and hedonistic drive highlight that within an organisation, the individuals and their feelings about the tools have an influence on the implementation (Awa et al. 2017). For the CSF *social influence*, the findings show that the initiatives for implementing BI-tools for municipalities are not solely driven by top-level leadership as literature otherwise indicate as something important for implementation (Goede, 2021; Jonathan, 2020; Raut et al. 2019; Sharda et al. 2018; Yeoh & Popovič, 2016; Ziemba, 2021), but that instead the implementation projects are often initiated in the middle-up by motivated employees on the operational level. Still, this is supported by the literature that is specific about municipalities, saying that this kind of initiation is common (Caudle et al. 1991; Digg, 2022a). In addition, Yeoh and Popovič (2016) also highlight the importance of the individual "championship" on technology implementation within an organisation. One respondent highly emphasised the importance of the indirect social powers that reside within the municipality and affects the initiation and implementation of projects, which supports the literature highlighting the importance of individual's roles and social status within the organisation (Awa et al. 2017). Hence, the importance of social influence might be highly apparent within just municipalities and emphasises the need to recognise the informal networks and interpersonal dynamics as they influence the implementation (Awa et al. 2017; Yeoh & Popovič, 2016).

Furthermore, this connects with the other CSF *hedonistic drive* that focuses on the enjoyment or pleasure of using the technology (Awa et al. 2017). The findings indicate the perceived user-friendliness and attractiveness of the BI-tools as drivers of engagement for the implementation. In addition, the findings indicate that there was an interest and an aspect of fun when working with the tools. Specifically, the tools' perceived ability to simplify complex data and present it in an engaging manner contributed to increased enjoyment and motivation among users according to the findings. However, feelings such as frustration with the performance of the tool and unsatisfied expectations were mentioned in the findings which

according to the literature tend to lead to a negative influence on the success of the implementation (Awa et al. 2017).

In the individual context, *social influence* and *hedonistic drive* significantly impact the implementation of BI-tools in municipalities. *Social influence* shows that motivated operational-level employees often initiate implementation projects, rather than just top-level leadership. Individual "championship" and informal networks within the municipality play crucial roles, with interpersonal dynamics greatly affecting project success. *Hedonistic drive* enhances engagement and motivation by simplifying complex data in an engaging way. However, negative feelings like frustration with tool performance can hinder success.

## 5.5 Task Context

*The following section considers the CSFs from the task context.*

As explained by Awa et al. (2017), matching the task demands with the technology capability influences the implementation positively, as this motivates its implementation. Regarding the first factor *task complexity,* this refers to the intricacy and difficulty involved in completing the tasks with environmental sustainability within the municipalities (Awa et al. 2017). The findings clearly show that there is a perceived complexity of working and addressing climate impact within the municipalities. As expressed by WCED (1987, s.16) the municipalities are working to meet the needs of the present citizens without compromising the ability of future generations to meet their own needs, a complex endeavour to handle. In addition, according to the findings there is an intricacy in working with sustainability, as the work involves handling the three dimensions of environmental, social, and economic (Kuhlman & Farrington, 2010; Goodland, 1995). This further connects to cognitively understanding how climate initiatives can be expressed in practice as there are many ways for how the municipality can address these issues, as was found to be challenging according to the findings. The literature further underscores this inherent complexity of integrating sustainability and managing ongoing efforts and policies (Kranz & Gustafsson, 2021; Keskitalo & Liljenfeldt, 2012).

Furthermore, the key factor *task interdependence* indicates the degree of connectivity or reliance between tasks, as well as departments within the municipality (Awa et al. 2017). In regard to the environmental aspect that this study focuses on, the findings indicate that there is an interdependence in handling the environmental data as it is rather fragmented across the municipalities' departments which leads to challenges in aggregating relevant information and delays in reporting on their sustainability work. The aggregation of data is crucial within the municipality to comprehensively handle their climate work, indicated by the findings and the literature (Kranz & Gustafsson, 2021; Keskitalo & Liljenfeldt, 2012). However, the municipal silos, and the challenges with cooperating across departments, something that is highly necessary for digital innovation, further complicates this process (Joukhadar et al. 2023; Digg, 2022). Furthermore, measuring the climate impact of the municipalities also means uncovering the ways that a certain service or product can impact the environment as indicated in the findings, an interdependence that is facilitated with the tools (Awa et al. 2017).

Because of the above mentioned complexities and interdependencies, according to the literature there is a motivation for using tools such as BI-tools to facilitate the complex work that comes with working with environmental sustainability within municipalities (Awa et al.

2017). The findings also indicate that the BI-tools in some cases are facilitating the complexity and interdependency of the tasks, as well as show hope that the tools in the future will help with this.

In summary, aligning task demands with technology positively influences sustainability efforts in municipalities. Municipalities must work with meeting needs without compromising future generations, making climate initiatives challenging. Tasks and departments within municipalities are interconnected, complicating the management of fragmented environmental data. Effective climate work requires data aggregation and cooperation across departments, which is often difficult. Measuring climate impact involves identifying all environmental effects of services or products, aided by technological tools. Due to these challenges, there is a strong motivation to use BI-tools, which help manage task complexity and interdependence, improving sustainability efforts.

## 5.6 Synthesising CSFs

The aim of the study was to develop an understanding of the implementation of BI-systems for environmental sustainability initiatives within municipalities with the help of what CSFs that the employees perceive as critical. The findings indicate that employees consider several CSFs crucial for the successful implementation of BI-systems for environmental sustainability within municipalities, as can be seen in Figure 5.1.

Firstly related to the technology context, *perceived simplicity*, *data quality and integrity*, and *available technology* were generally seen as important by the employees. The findings show that there is a perceived challenge with creating a cohesive architecture and infrastructure, as well as maintaining a sufficient quality of the data within the municipality. However, as the BI-systems often were not integrated with their current system, only data quality emerges as an important CSF. Secondly, the CSFs about the organisational dimension arise as some of the more important, as most of these were perceived as having an influence on implementation. Likewise, Ain et al. (2019) highlight that the organisational aspects are important for many organisations to consider when implementing. Interestingly, the CSF *TMS* appears to have low perceived influence on implementation, despite its importance highlighted in the literature (Goede, 2021; Jonathan, 2020; Raut et al. 2019; Sharda et al. 2018; Yeoh & Popovič, 2016; Ziemba, 2021). Furthermore, organisational context is important, as it underlies other factors such as technology. For instance, a more data-driven and technology-accepting organisational culture could enhance the perceived value and simplicity of technological solutions. Hence, there is a symbiosis between the different factors that highlights the interdependence between these, necessary for successful implementation. Thirdly, the environmental context mainly highlights *funding*, *political powers*, and *regulatory frameworks* as important, even though its influences were debated in the findings, while there was less support for *quality of information infrastructure*, *citizen participation*, and *mimetic pressures*. Fourthly, the individual context shows that employees perceive individuals within their organisation to have power and feelings that influence the implementation. Lastly, the task context also provides important CSFs, especially in the aspect of working with sustainability within the municipality, as the CSFs connected to the task context highlight the importance to mitigate the complexity and interdependence with the help of the BI-tools.

Furthermore, three new CSFs were identified from the findings. In the municipal context, the CSF *available technology* is particularly relevant because municipalities often struggled to find comprehensive systems that met all their environmental work needs, requiring different systems for various operations. Moreover, the CSF *available time* was also an important aspect, as municipalities had challenges with allocating time and experienced lack of motivation when implementing. The last identified CSF *governmental support* indicates that support and coordination on a nation-wide scale could facilitate the efforts.

Moreover, the study's findings did not always align with the literature. It can be due to several reasons, one of which is that the studies may have focused on different types of organisations or systems, resulting in variations in the perceived importance of different CSFs. Implementing technology solutions in the public sector presents a distinct context, with its own challenges (Caudle et al. 1991), as could be seen in the findings where the perceptions of the employees differed. Furthermore, each municipality's unique organisational context, shaped by several factors, influences how different CSFs are prioritised. In regard to the CSFs that were not perceived as important by the employees, this could be explained with a reference to dynamic capabilities. As, when a dynamic capability within an organisation becomes the norm within the industry, the capability before seen as an advantage becomes obsolete and only a foundation for staying in the market at all. The same principles could be applied to the CSFs, as the findings indicate that the respondents do not always find CSF as critical, because they are merely the foundation for the implementation in the first place, such as *TMS* and *quality of information infrastructure*.

It is worth highlighting that the municipalities that were interviewed for this study are all in the beginning stages of their systems' implementation journey. For this reason, we cannot argue that the perceived CSF by employees of these municipalities will in actuality be important factors for the implementation of these systems. However, the knowledge of these perceptions can help us better understand the people conducting the system implementations and in turn help us better understand the implementation process itself. In essence, as perceived from the perspectives of the employees, the implementation of BI-tools in municipalities hinges on a nuanced understanding of these contexts and the intricacy between technology, organisation, environment, individual dynamics, and task demands. Understanding and managing these factors can help municipalities obtain the full potential of BI-tools when addressing environmental sustainability initiatives, ultimately creating public value for the citizens in the long run.

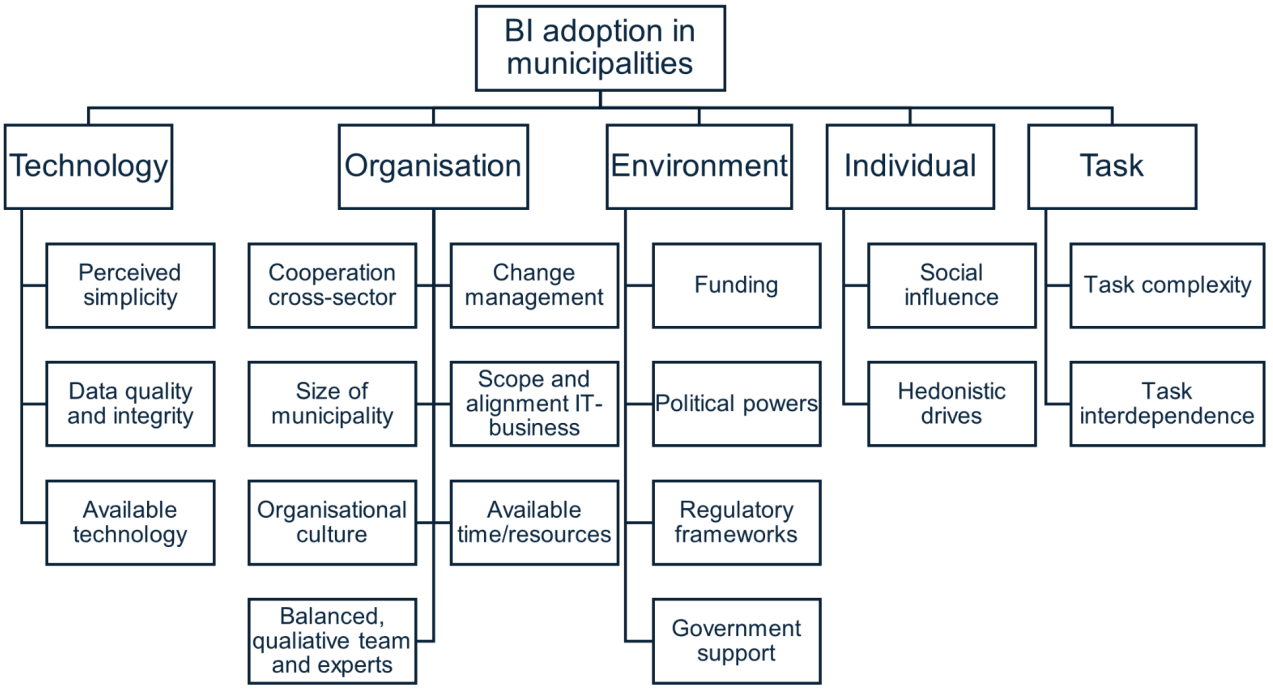


**Figure 5.1:** CSFs for BI Implementation in Swedish Municipalities

Figure 5.1 is a summary of the findings made from the perception of municipal employees according to the Integrated T-O-E theory regarding CSFs for the implementation of BI-systems for environmental sustainability within municipalities. The figure highlights the factors that were most clearly evident based on the findings from employees' perceptions of the implementation of BI-systems for sustainability initiatives. The findings did not show strong patterns for the factors of *perceived values*, *compatibility and interoperability*, *data architecture and infrastructure*, *data security and compliance*, *TMS*, *mimetic pressure*, *citizen participation*, *quality of national information infrastructure* and thus these have not been included in this figure.

# 6 Conclusion

The purpose of this study was to explore municipal employees' perception of CSFs for implementing BI-tools within municipalities for environmental sustainability initiatives, with the aim to provide insights into how municipalities can implement BI effectively to support their sustainability efforts and contribute to the current discourse of the selected field. To do this the following research question was posed: W*hat factors do municipal employees perceive as critical to the successful implementation of BI for environmental sustainability initiatives?* For this purpose, a qualitative study where data, through semi-structured interviews, were collected from six respondents working at different municipalities in Sweden. The collected data was analysed and discussed with a template analysis based on the CSF derived from literature and the Integrated T-O-E framework, to uncover and understand the CSF from the perspectives of the employees.

The findings of the study confirm some of the results of previous studies. For example, the CSFs *perceived simplicity*, *data quality*, and *available technology* in the technological aspect were perceived as important. Throughout, the CSFs in the organisational context were perceived as critical by the municipal employees, only *TMS* did not seem to influence implementation. The CSFs in the environmental context that were perceived as important were *funding*, *political powers*, and *regulatory frameworks*. Furthermore, *social influence* and *hedonistic drive*, as well as *task complexity* and *task interdependence*, from individual and task context influenced implementation according to the employees. Moreover, the study also identified three additional CSFs tailored to the municipal context: *available technology*, *available time*, and *governmental support*. Furthermore, the findings highlighted discrepancies with existing literature where the unique municipal context influences how different CSFs are perceived and prioritised.

Furthermore, this study adds valuable insights to implementing BI-tools within municipalities and specifically for environmental sustainability. While people are complex and their interpretations of the work with the BI-tools are what affects its use, the paper contributes to an enhanced understanding and extension of the Integrated T-O-E framework with the addition of a perspective from municipal employees on BI and environmental sustainability. A perspective that was previously missing from the theory. In addition, the paper contributes to the current discourse within the selected field in IS research, narrowing the found gap in literature. Finally, the paper entails important practical implications, as its content can be utilised in municipalities as well as in governmental institutions to understand the current work being done with business intelligence for environmental sustainability, a highly relevant subject for municipalities today.

## 6.1 Future Research

As literature has shown, the research of the intersection between environmental sustainability, municipality and business intelligence have not been widely studied. While municipalities are starting to utilise BI-tools for sustainability, it can be of interest to follow how this develops later on. Especially related to this paper, as a majority of the municipalities were in the process of implementing and therefore the finalised adoption would further provide

implications for implementing BI-tools within municipalities. Moreover, in future studies, a larger sample group should be included to draw stronger conclusions and achieve greater reliability. In addition, as the research extended the Integrated T-O-E framework with specific CSF for the context, should these CSF be further studied to confirm or deny their relevance. Moreover, if smaller municipalities decide to adopt BI for environmental sustainability as well, then research could be applied to this differentiating context, in addition to bigger municipalities. As well as to study the readiness of other Swedish municipalities, based on the implications of the findings.

# Appendix 1 - Interview Guide

| Subject | Questions | CSF | References | Description |
|---|---|---|---|---|
| Initial | **1:** Present yourself and your role within the municipality? | | | |
| Definition BI | **2:** We define BI as follows, “a broad category of technologies, applications, and processes for gathering, storing, accessing, and analysing data to help its users make better decisions”. How does this correspond to your definition of BI? | | Wixom & Watson, 2010, p.14 | |
| Implementation of BI-tool | **3a:** Have your municipality implemented business intelligence-tools for sustainability initiatives?<br>**3b**: When did the implementation occur? | | | |

| | | | | |
|---|---|---|---|---|
| | **3c**: What specific BI-tools did you implement? | | | |
| Motivation for implementation | **4a:** Can you describe why your municipality decided to implement BI tools for sustainability initiatives?<br><br>**4b**: For what initiatives and operations are you using these tools? | Scope and alignment IT-business | Awa et al. 2017; Yeoh and Popovič, 2016 | Scope of business operations influences the possibility to adopt to new technologies (the larger the higher possibility) |
| **T-O-E concept** | **Questions** | **CSF** | **References** | **Description** |
| Technological | **5a:** How was your perception of how easy/hard the system was to use when implementing it?<br><br>**5b**:What expectations did you have regarding the BI-tools value? | Perceived simplicity, Perceived values | Awa et al. 2017 | How easy the system is to use.<br><br>How valuable it is perceived to be. |
| | **6:** How well is the BI-tool integrated and compatible with existing systems within the municipality, between different departments? | Compatibility, interoperability and standards within the public sector, | Awa et al. 2017, Jonathan, 2020 | How well it works with existing tools.<br><br>Between systems within the municipality. Interoperability is needed for collaboration. |

| | | | | |
|---|---|---|---|---|
| | **7**: How do you think that the data architecture and infrastructure within the municipality has influenced the implementation? | Data architecture, Data infrastructure | Jonathan, 2020 Sharda et al. 2018; Yeoh and Popovič, 2016; Goede, 2021 | Design and organisation of components in the system (data models, ETL, BI-tools), Physical and technical components (databases, network, servers) |
| | **8:** How do you think that data quality and integrity used within the municipality have influenced the implementation? | Data quality and integrity, Data-driven agility | Yeoh and Popovič, 2016; Ziemba, 2021 Jonathan, 2020 | Having a "single version of the truth". Functionality, reliability, usability, efficiency, maintainability, and portability. Integrity - data remains unchanged and uncorrupted. |
| | **9:** How do you think that data security and compliance have influenced the implementation? | Data security and compliance | Jonathan, 2020 | Cannot fully digitalise before security and compliance measures are in place. |
| Organisational | **10:** How are you cooperating in this area across the departments within the municipality? | Cooperation cross-sector | Krantz & Gustafsson, 2021 | Important to understand for example sustainability across sectors in the municipality |
| | **11a:** How do you think that the team has influenced the implementation?<br><br>**11b:** How do you think that | Balanced and qualitative team<br><br>BI and sustainability experts | Goede, 2021; Yeoh & Popovič, 2016<br><br>Zhang et al. 2022 | Competent BI team with appropriate business and technical skills. |

| | | | | |
|---|---|---|---|---|
| | the use of BI and sustainability experts has influenced the implementation? | | | |
| | **12:** What was the role of top management in implementation? | Top management support | Awa et al. 2017; Goede, 2021; Jonathan, 2020; Raut et al. 2019; Sharda et al. 2018; Yeoh & Popovič, 2016; Ziemba, 2021 | The support of top management is important when implementing BI (encourage, motivation) |
| | **13:** How do you think that the size of your municipality has influenced the implementation? | Size of municipality | Awa et al. 2017 | The size of the firm affects adoption of new technology, for ex large firms tend to adopt technology faster than smaller firms |
| | **14:** How do you think that the culture within the municipality has influenced the implementation? | Organisational culture | Sharda et al. 2018; Jonathan, 2020; Zaamer et al. 2022; Ziemba, 2021 | Normer, värderingar, struktur. Fact-based decision-making culture. Intuition vs data regarding decision-making.<br><br>The role of data. |
| | **15**: How have you addressed the needs and experiences of those having to use the BI-tool? | Change management | Goede; 2021; Yeoh and Popovič, 2016; Jonathan, 2020 | Addressing the needs and experiences of those being affected by the system. |
| Environmental | **16**: How have external parties such as other municipalities influenced your | Mimetic pressure | Awa et al. 2017 | Pressure from competitors to adopt new technology. Inspiration from |

| | | | | |
|---|---|---|---|---|
| | implementation? | | | other municipalities. |
| | **17:** How has funding for the project influenced the implementation? | Funding (normative) | Awa et al. 2017; Jonathan, 2020; Ziemba, 2021 | |
| | **18:** How has political powers influenced the implementation? | Political powers (normative) | Awa et al. 2017; Jonathan, 2020 | |
| | **19:** How has citizen participation influenced the implementation? | Citizen participation (normative) | Awa et al. 2017; Jonathan, 2020 | |
| | **20:** How has regulatory frameworks influenced the implementation? | Regulatory frameworks (normative) | Awa et al. 2017; Jonathan, 2020 | |
| | **21:** How has the quality of Swedish information infrastructure influenced the implementation? | Quality of national information infrastructure (normative) | Awa et al. 2017; Jonathan, 2020 | Telecommunications, landlines. |
| Individual | **22:** How do you think that the people related to this project influence each other? | Social influence | Awa et al. 2017 | When group members show cohesiveness to the common norms and values relating to technology, they tend to adopt faster |
| | **23:** How do you think that the satisfaction and enjoyment for using the BI-tool has influenced | Hedonistic drive | Awa et al. 2017 | Emotional drivers. How fun and exciting you think that it would be to use. |

| | | | | |
|---|---|---|---|---|
| | the implementation? | | | |
| Task | **24:** How has the complexity of the tasks associated with environmental sustainability work influenced the implementation? | Task complexity | Awa et al. 2017 | The complexity of tasks positively affects technology adoption. Complex tasks → adopt technologies → less complex |
| | **25:** To what extent are tasks relating to environmental sustainability work interdependent of each other? | Task interdependence | Awa et al. 2017 | Tasks that are interdependent with others motivate the adoption of technologies to facilitate task processes more than tasks that are almost alone. |
| Success | **26a:** How successful do you think that the implementation has been?<br><br>**26b:** How well is the BI-tool corresponding to the objectives that you had for the system? | Scope and alignment IT-business | Sharda et al. 2018; Yeoh and Popovič, 2016; Jonathan, 2020 | Align BI strategy with business objectives |
| Other | **27:** Is there anything else you would like to add? | | | |

# Appendix 2 - AI Contribution Statement

**Tools used**: ChatGPT 3.5, ChatGPT 4, Whisper.

**Degree of use**: Improved language in sentences or in paragraphs where we felt that there was a need for it, transcribed all of the audio recordings to text, which then were controlled manually and used, summarised the result sections in bullet points to obtain a condensed and comprehensive overview that facilitated for when working on the discussion, finally looked up synonyms and translated texts from Swedish to English. Finally, all usage of the AI tools were thoroughly controlled, read-through, and changed as needed.

# References

Ain, N., Vaia, G., DeLone, W. H., & Waheed, M. (2019). Two decades of research on business intelligence system adoption, utilization and success–A systematic literature review. *Decision Support Systems*, *125*, 113113. doi: 10.1016/j.dss.2019.113113

Allam, Z., & Dhunny, Z. A. (2019). On big data, artificial intelligence and smart cities. *Cities*, 89, pp. 80-91. doi: 10.1016/j.cities.2019.01.032

Appelbaum, D., Kogan, A., Vasarhelyi, M., & Yan, Z. (2017). Impact of business analytics and enterprise systems on managerial accounting. *International journal of accounting information systems*, 25, pp. 29-44. doi: 10.1016/j.accinf.2017.03.003

Ashrafi, A., Ravasan, A. Z., Trkman, P., & Afshari, S. (2019). The role of business analytics capabilities in bolstering firms' agility and performance. *International Journal of Information Management*, 47, pp. 1-15. doi: 10.1016/j.ijinfomgt.2018.12.005

Awa, H. O., Ojiabo, O. U., & Orokor, L. E. (2017). Integrated technology-organization-environment (TOE) taxonomies for technology adoption. *Journal of Enterprise Information Management*, *30*(6), pp. 893-921. doi: 10.1108/JEIM-03-2016-0079

Bell, E., Bryman, A., & Harley, B. (2019). *Business research methods*. Fifth edition, Oxford university press.

Bengtsson, F., & Ågerfalk, P. J. (2011). Information technology as a change actant in sustainability innovation: Insights from Uppsala. *The Journal of Strategic Information Systems*, 20(1), pp. 96-112. doi: 10.1016/j.jsis.2010.09.007

Bhattacherjee, A. (2012). Social science research: Principles, methods, and practices. University of South Florida.

Bibri, S. E., & Krogstie, J. (2020). The emerging data–driven Smart City and its innovative applied solutions for sustainability: The cases of London and Barcelona. *Energy Informatics*, 3, pp. 1-42. doi: 10.1186/s42162-020-00108-6

Bryman, A. (2016). Social research methods. Oxford university press.

Carlsson, F., Matteby, M., Magnusson, J., & Berbyuk Lindstrom, N. (2023). Collective digital transformation: Institutional work in municipal collaboration. *Proceedings of the 24th Annual International Conference on Digital Government Research*, pp. 583-592. doi: 10.1145/3598469.3598536

Caudle, S. L., Gorr, W. L., & Newcomer, K. E. (1991). Key information systems management issues for the public sector. *MIS quarterly*, pp. 171-188. doi: 10.2307/249378

Chatterjee, S., Rana, N. P., & Dwivedi, Y. K. (2024). How does business analytics contribute to organisational performance and business value? A resource-based view. *Information Technology & People*, *37*(2), pp. 874-894. doi: 10.1108/ITP-08-2020-0603

Chen, A. and Roberts, N. (2024), "Joint drivers of different shades of green IT/IS practices: a strategic cognition perspective", Information Technology & People, Vol. 37 No. 3, pp. 1103-1125. doi: 10.1108/ITP-07-2022-0562

Chen, H., Chiang, R. H., & Storey, V. C. (2012). Business intelligence and analytics: From big data to big impact. *MIS quarterly*, pp. 1165-1188, doi: 10.2307/41703503

Chen, Y. C. (2017). Managing digital governance: issues, challenges, and solutions. Routledge.

Cheng, J., Singh, H. S. M., Zhang, Y. C., & Wang, S. Y. (2023). The impact of business intelligence, big data analytics capability, and green knowledge management on sustainability performance. *Journal of Cleaner Production*, 429, 139410. doi: 10.1016/j.jclepro.2023.139410

ClimateView. (n.d.). Defining Transition Planning, Available online: https://www.climateview.global/en [Accessed 17 May 2024]
Digg. (2022a). Tekniskt perspektiv, Available online: https://www.digg.se/kunskap-och-stod/svenskt-ramverk-for-digital-samverkan/rekommendationer-for-offentliga-organisationer/tekniskt-perspektiv [Accessed 8 April 2024]
Digg. (2022b). Informations- och dataperspektivet, Available online: https://www.digg.se/kunskap-och-stod/svenskt-ramverk-for-digital-samverkan/rekommendationer-for-offentliga-organisationer/informations--och-dataperspektivet [Accessed 10 April 2024]
Digg. (2023). Styrnings- och ledningsperspektiv på digital samverkan, Available online: https://www.digg.se/kunskap-och-stod/svenskt-ramverk-for-digital-samverkan/rekommendationer-for-offentliga-organisationer/styrnings--och-ledningsperspektiv-pa-digital-samverkan#h-1Integreradigitaliseringsarbetetidenordinarieverksamheten [Accessed 8 April 2024]
Estevez, E., Janowski, T., & Dzhusupova, Z. (2013). Electronic governance for sustainable development: how EGOV solutions contribute to SD goals?. In *Proceedings of the 14th annual international conference on digital government research*, pp. 92-101. doi: 10.1145/2479724.2479741
European Commission. (n.d). Corporate Sustainability Reporting. Available online: https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en [Accessed 3 April 2024]
Feroz, A. K., Zo, H., & Chiravuri, A. (2021). Digital transformation and environmental sustainability: A review and research agenda. *Sustainability*, 13(3), 1530. doi: 10.3390/su13031530
Futureproofed. (n.d.). Build and execute your sustainability roadmap, Available online: https://www.futureproofed.com/ [Accessed 17 May 2024]
Gangwar, H., Date, H., & Raoot, A. D. (2014). Review on IT adoption: insights from recent technologies. *Journal of enterprise information management*, 27(4), pp. 488-502. doi: 10.1108/JEIM-08-2012-0047
Gholami, R., Watson, R. T., Hasan, H., Molla, A., & Bjorn-Andersen, N. (2016). Information systems solutions for environmental sustainability: How can we do more?. *Journal of the Association for Information Systems*, *17*(8), 2, doi: 10.17705/1jais.00435
Gillon, K., Aral, S., Lin, C. Y., Mithas, S., & Zozulia, M. (2014). Business analytics: radical shift or incremental change?. *Communications of the Association for Information Systems*, 34(1), 13. doi:10.17705/1CAIS.03413
Goede, R. (2021). Sustainable business intelligence systems: Modelling for the future. *Systems Research and Behavioral Science*, 38(5), pp. 685-695, doi: 10.1002/sres.2813
Goldkuhl, G. (2012). Pragmatism vs interpretivism in qualitative information systems research. *European journal of information systems*, 21, pp. 135-146. doi: 10.1057/ejis.2011.54
Goodland, R. (1995). The concept of environmental sustainability. *Annual review of ecology and systematics*, 26(1), pp. 1-24, doi: 10.1146/annurev.es.26.110195.000245
Google. (n.d.). Environmental Insights Explorer, Available online: https://insights.sustainability.google/ [Accessed 17 May 2024]
Hassan, N. R., & Mingers, J. (2018). Reinterpreting the Kuhnian paradigm in information systems. *Journal of the Association for Information Systems*, 19(7), 6. doi: 10.17705/1jais.00502

Hassan, N. R., Mingers, J., & Stahl, B. (2018). Philosophy and information systems: where are we and where should we go?. *European Journal of Information Systems*, 27(3), pp. 263-277. doi: 10.1080/0960085X.2018.1470776

IBM. (2020). The rise of the sustainable enterprise: using digital tech to respond to the environmental imperative. Available online: https://www.businessofgovernment.org/sites/default/files/The%20rise%20of%20the%20sustainable%20enterprise.pdf [Accessed 18 May 2024]

IPCC. (2022). Climate change 2022: impacts, adaptation and vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Available online: https://report.ipcc.ch/ar6/wg2/IPCC_AR6_WGII_FullReport.pdf [Accessed 18 April 2024]

Jonathan, G. M. (2020). Digital transformation in the public sector: Identifying critical success factors. In Information Systems: 16th European, Mediterranean, and Middle Eastern Conference, EMCIS 2019, Dubai, United Arab Emirates, December 9–10, 2019, Proceedings 16, pp. 223-235. *Springer International Publishing*, doi: 10.1007/978-3-030-44322-1_17

Joukhadar, G., Jiang, R., Harrington, K., & Thorogood, A. (2023). Promoting Digital Innovation for Sustainability in the Public Sector. *Communications of the Association for Information Systems*, 53(1), 13. doi: 10.17705/1CAIS.05310

Keskitalo, E. C. H., & Liljenfeldt, J. (2012). Working with sustainability: Experiences of sustainability processes in Swedish municipalities. In *Natural resources forum* (Vol. 36, No. 1, pp. 16-27). Oxford, UK: Blackwell Publishing Ltd. doi: 10.1111/j.1477-8947.2012.01442.x

Kirst, E., & Lang, D. J. (2019). Perspectives on Comprehensive Sustainability-Orientation in Municipalities: Structuring Existing Approaches. *Sustainability*, 11(4), 1040. doi: 10.3390/su11041040

Krantz, V., & Gustafsson, S. (2021). Localizing the sustainable development goals through an integrated approach in municipalities: Early experiences from a Swedish forerunner. *Journal of Environmental Planning and Management*, *64*(14), pp. 2641-2660. doi: 10.1080/09640568.2021.1877642

Kuhlman, T., & Farrington, J. (2010). What is sustainability?. *Sustainability*, 2(11), pp. 3436-3448, doi:10.3390/su2113436

Lautenbach, P., Johnston, K., & Adeniran-Ogundipe, T. (2017). Factors influencing business intelligence and analytics usage extent in South African organisations. *South African Journal of Business Management*, *48*(3), pp. 23-33, doi: 10.4102/sajbm.v48i3.33

Lee, A. S. (1991). Integrating positivist and interpretive approaches to organizational research. *Organization science*, 2(4), pp. 342-365, doi: 10.1287/orsc.2.4.342

Lee, A. S. (2004). Thinking about social theory and philosophy for information systems. *Social theory and philosophy for information systems*, 1, 26.

Loeser, F., Recker, J., Brocke, J. V., Molla, A., & Zarnekow, R. (2017). How IT executives create organizational benefits by translating environmental strategies into Green IS initiatives. *Information Systems Journal*, 27(4), pp. 503-553. doi: 10.1111/isj.12136

Melville, N. P. (2010). Information systems innovation for environmental sustainability. *MIS quarterly*, pp. 1-21. doi: 10.2307/20721412

Miljöbarometern. (n.d.). Miljöbarometern: Ett verktyg - Många möjligheter, Available online: https://miljobarometern.se/ [Accessed 17 May 2024]

Moore, J. E., Mascarenhas, A., Bain, J., & Straus, S. E. (2017). Developing a comprehensive definition of sustainability. *Implementation Science*, 12, pp. 1-8, doi: 10.1186/s13012-017-0637-1

Muntean, M. (2018). Business intelligence issues for sustainability projects. *Sustainability*, 10(2), 335. doi: 10.3390/su10020335

Oates, B. J., Griffiths, M., & McLean, R. (2022). *Researching information systems and computing*. Second edition, Sage.

OECD (2019), Digital Government Review of Sweden: Towards a Data-driven Public Sector, OECD Digital Government Studies, OECD Publishing, Paris. doi: 10.1787/4daf932b-en

Olszak, C. M., & Ziemba, E. (2012). Critical success factors for implementing business intelligence systems in small and medium enterprises on the example of upper Silesia, Poland. *Interdisciplinary Journal of Information, Knowledge, and Management*, *7*, 129. doi: 10.28945/1584

OpenAI. (n.d.). Introducing Whisper. Available online: https://openai.com/research/whisper [Accessed 17 April 2024]

Pang, M. S., Lee, G., & DeLone, W. H. (2014). IT resources, organizational capabilities, and value creation in public-sector organizations: a public-value management perspective. *Journal of Information Technology*, 29, pp. 187-205. doi: 10.1057/jit.2014.2

Patton, M. Q. (2015). Qualitative Research & Evaluation Methods: Integrating Theory and Practice. Fourth edition, SAGE.

Petrini, M., & Pozzebon, M. (2009). Managing sustainability with the support of business intelligence: Integrating socio-environmental indicators and organisational context. *The journal of strategic information systems*, 18(4), pp. 178-191. doi: 10.1016/j.jsis.2009.06.001

Piotrowicz, W., & Cuthbertson, R. (2009). Sustainability–a new dimension in information systems evaluation. *Journal of Enterprise Information Management*, *22*(5), pp. 492-503. doi: 10.1108/17410390910993509

Puklavec, B., Oliveira, T., & Popovič, A. (2018). Understanding the determinants of business intelligence system adoption stages: An empirical study of SMEs. *Industrial Management & Data Systems*, *118*(1), pp. 236-26. doi: 10.1108/IMDS-05-2017-0170

PWC. (2023). Kommunal hållbarhetsstyrning - för kommuninvånarnas bästa! Available online:https://www.pwc.se/sv/offentlig-sektor/kommunal-hallbarhetsstyrning-april-2023.pdf [Accessed 18 April 2024]

Ramanathan, R., Philpott, E., Duan, Y., & Cao, G. (2017). Adoption of business analytics and impact on performance: a qualitative study in retail. *Production Planning & Control,* 28(11-12), pp. 985-998. doi: 10.1080/09537287.2017.1336800

Raut, R. D., Mangla, S. K., Narwane, V. S., Gardas, B. B., Priyadarshinee, P., & Narkhede, B. E. (2019). Linking big data analytics and operational sustainability practices for sustainable business management. *Journal of cleaner production,* 224, pp. 10-24. doi: 10.1016/j.jclepro.2019.03.181

Recker, J. (2013). Scientific Research in Information Systems: A Beginner's Guide. Springer, Berlin Heidelberg

Ripgården, J. (2021). Hur bra är 50 svenska kommuner egentligen på att skapa nytta av data? Available online: https://www.atea.se/datadrivet-och-automation/50-svenska-kommuner-nytta-av-data/ [Accessed 8 April 2024]

Rockart, J. F. (1978). A new approach to defining the chief executive's information needs. *Alfred P. Sloan School of Management MIT*.

RUS. (2020). Vägledning för lokalt arbete med miljömål och Agenda 2030, Available online: https://www.rus.se/wp-content/uploads/Vagledning-for-lokalt-arbete-med-miljomal-och-Agenda-2030.pdf [Accessed 26 April 2024]

Salwani, M.I. , Marthandan, G. , Norzaidi, M.D. and Chong, S.C. (2009), E-commerce usage and business performance in the Malaysian tourism sector: empirical analysis. *Information Management & Computer Security*, Vol. 17 No. 2, pp. 166-185. doi: 10.1108/09685220910964027

SCB. (2024). Folkmängd, topp 50, 31 december 2023. Available online: https://www.scb.se/hitta-statistik/statistik-efter-amne/befolkning/befolkningens-sammansattning/befolkningsstatistik/pong/tabell-och-diagram/folkmangd-och-befolkningsforandringar---helarsstatistik/folkmangd-topp-50/ [Accessed 16 April 2024]

Schultze, U., & Avital, M. (2011). Designing interviews to generate rich data for information systems research. *Information and organization*, 21(1), pp. 1-16. doi: 10.1016/j.infoandorg.2010.11.001

Seidel, S., Recker, J., & Vom Brocke, J. (2013). Sensemaking and sustainable practicing: functional affordances of information systems in green transformations. *MIS quarterly*, pp. 1275-1299. doi: 10.25300/MISQ/2013/37.4.13

SFS 1974:152 *Instrument of Government (Regeringsformen)*. Stockholm: Ministry of Justice.

SFS 1995:1554 *Annual Accounts Act (Årsredovisningslagen)*. Stockholm: Ministry of Justice.

SFS 2017:275 *Local Government Act (Kommunallagen)*. Stockholm: Ministry of Finance.

SFS 2018:597 *Municipal Accounting Act (Lag om kommunal bokföring och redovisning)*. Stockholm: Ministry of Finance.

Sharda, R., Delen, D., & Turban, E. (2018). Business intelligence, analytics, and data science: a managerial perspective. Pearson

Sharma, A. K., Sharma, D. M., Purohit, N., Rout, S. K., & Sharma, S. A. (2022). Analytics techniques: descriptive analytics, predictive analytics, and prescriptive analytics. *Decision Intelligence Analytics and the Implementation of Strategic Business Management*, pp. 1-14. doi: 10.1007/978-3-030-82763-2_1

Shi, Y., Van Toorn, C., & McEwan, M. (2023). Exploration–Exploitation: How business analytics powers organisational ambidexterity for environmental sustainability. *Information Systems Journal*. doi: 10.1111/isj.12456

SKL. (2019) Utveckling i en digital tid, Available online: https://skr.se/download/18.45167e4317e2b341b24dc934/1643025710932/Utveckling%20i%20en%20digital%20tid%2020190620.pdf [Accessed 25 March 2024]

SKR. (2021). Så styrs Sverige, Available online: https://skr.se/skr/tjanster/kommunerochregioner/faktakommunerochregioner/sastyrssverige.3054.html [Accessed 10 April 2024]

SKR. (2022). Kommuner och regioner, Available online: https://skr.se/skr/tjanster/kommunerochregioner.431.html [Accessed 25 March 2024]

SKR. (2023a). Kommunernas åtaganden. Available online: https://skr.se/skr/tjanster/kommunerochregioner/faktakommunerochregioner/kommunernasataganden.3683.html [Accessed 25 March 2024]

SKR. (2023b). Smartare samhällsbyggnad, Available online: https://skr.se/skr/tjanster/rapporterochskrifter/publikationer/smartaresamhallsbyggnad.77844.html [Accessed 3 April 2024]

SKR. (2023c). Kommunernas klimatarbete, Available online: https://skr.se/download/18.18d53e5a18a17749962daf54/1694180201326/Kommunernas-klimatarbete-SKR-enkat-2023.pdf [Accessed 26 April 2024]

SKR. (2023d). Miljömål, Available online: https://skr.se/skr/samhallsplaneringinfrastruktur/miljohalsa/miljomal.3277.html [Accessed 26 April 2024]

SKR. (2024). Styra med Agenda 2030, Available online: https://skr.se/skr/demokratiledningstyrning/styrningledning/styrledningssystemarbetsstatt/styraforresultat/styramedagenda2030.55221.html [Accessed 15 April 2024]
Stjepić, A. M., Pejić Bach, M., & Bosilj Vukšić, V. (2021). Exploring risks in the adoption of business intelligence in SMEs using the TOE framework. *Journal of Risk and Financial Management*, *14*(2), 58. doi: 10.3390/jrfm14020058
Sustainable Advantage. (n.d.). Framtiden inom hållbarhetsplanering, Available online: https://www.sustainableadvantage.io/ [Accessed 17 May 2024]
Svalna. (n.d.). Comprehensive climate analysis for companies and organizations, Available online: https://svalna.se/web/en/products/carbon-intelligence [Accessed 17 May 2024]
Twizeyimana, J. D., & Andersson, A. (2019). The public value of E-Government–A literature review. *Government information quarterly*, *36*(2), pp. 167-178. doi: 10.1016/j.giq.2019.01.001
UNDP. (n.d.) Sustainable Development Goals, Available Online: https://www.undp.org/sustainable-development-goals [Accessed 26 March 2024]
UN General Assembly. (2015). A/RES/70/1. Transforming our world: the 2030 Agenda for Sustainable Development, Available online: https://sdgs.un.org/2030agenda [Accessed 15 April 2024]
Visvizi, A., Lytras, M. D., Damiani, E., & Mathkour, H. (2018). Policy making for smart cities: Innovation and social inclusive economic growth for sustainability. *Journal of Science and Technology Policy Management*, 9(2), pp. 126-133. doi: 10.1108/JSTPM-07-2018-079
Watson, R. T., Boudreau, M. C., & Chen, A. J. (2010). Information systems and environmentally sustainable development: energy informatics and new directions for the IS community. *MIS quarterly*, pp. 23-38. doi: 10.2307/20721413
WCED, S. W. S. (1987). World commission on environment and development. *Our common future*, *17*(1), 1-91.
Webster, J. and Watson, R.T., 2002. Analyzing the past to prepare for the future: Writing a literature review. *MIS quarterly*, pp. xiii-xxiii.
Wiles, R. (2012). What are qualitative research ethics?. Bloomsbury Academic.
Wixom, B., & Watson, H. (2010). The BI-based organization. *International Journal of Business Intelligence Research (IJBIR)*, *1*(1), pp. 13-28. doi: 10.4018/jbir.2010071702
Yasmeen, H., Wang, Y., Zameer, H., & Ismail, H. (2020). Modeling the role of government, firm, and civil society for environmental sustainability. In *Developing Eco-Cities Through Policy, Planning, and Innovation: Can It Really Work?* pp. 62-83. IGI Global. doi: 10.4018/978-1-7998-0441-3.ch003
Yeoh, W., & Koronios, A. (2010). Critical success factors for business intelligence systems. *Journal of computer information systems*, *50*(3), pp. 23-32. doi: 10.1080/08874417.2010.11645404
Yeoh, W., & Popovič, A. (2016). Extending the understanding of critical success factors for implementing business intelligence systems. *Journal of the Association for Information Science and Technology*, 67(1), pp. 134-147, doi: 10.1002/asi.23366
Zameer, H., Wang, Y., Yasmeen, H., & Mubarak, S. (2022). Green innovation as a mediator in the impact of business analytics and environmental orientation on green competitive advantage. *Management Decision*, 60(2), pp. 488-507, doi: 10.1108/MD-01-2020-0065
Zhang, D., Pan, S. L., Yu, J., & Liu, W. (2022). Orchestrating big data analytics capability for sustainability: A study of air pollution management in China. *Information & Management*, 59(5), 103231. doi: 10.1016/j.im.2019.103231

Ziemba, E. (2021). The contribution of ICT adoption by local governments to sustainability—Empirical evidence from Poland. *Information Systems Management*, 38(2), pp. 116-134. doi: 10.1080/10580530.2020.1738600